Engineering Library

MAR 8 1932

ELECTRICAL WORLD

March 5, 1932
McGraw-Hill Publishing Company, Inc.
25 cents per copy

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

"SPECIFY ANACONDA! They furnish engineering service with a good product"

You must DO MORE than dust it off

MODEL 432 WATTMETER

The Weston Junior Line consists of Model 432 D. C. and single phase A. C. Wattmeters, Model 433 A. C. Ammeters and Voltmeters—available in a wide list of range combinations.

Today, hundreds of motors are doing work for which they were not originally bought nor designed. The demand for "economy" has forced plant Maintenance Departments to substitute motors from inactive machines rather than repair those in use.

Putting motors, idle for months, into the regular production line is risky business—unless a comprehensive, accurate check is made of the operating conditions and the motor.

Motors, idle or active, are affected by moisture, heat, dust, dirt and gas. Seldom is the danger evident to the eye before damage occurs. To prevent failure—insulation, windings, brushes, contacts must be tested thoroughly . . . line voltages and load verified. And the only economical, dependable means is with reliable, accurate electrical measuring instruments.

Lowering power costs, retarding depreciation, preventing costly interruptions of production, the Weston "Junior" portable testing instruments have earned their cost many times over in thousands of plants. Cutting costs, ruggedly constructed, they particularly help the maintenance man meet today's urgent need for *true* economy.

Weston will gladly show you how these instruments can be made to pay their way in your plant. A competent representative will call on request.

WESTON

ELECTRICAL INSTRUMENT CORPORATION

578 FRELINGHUYSEN AVENUE **NEWARK, N. J.**

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

ALLEN M. PERRY
Managing Editor

EARL WHITEHORNE
Contributing Editor

G. F. WITTIG
Statistical Editor

H. M. CAMERON
Associate Editor

A. E. KNOWLTON
Associate Editor

F. C. WELLS
News Editor

E. R. SEARLES
Assistant Editor

L. W. W. MORROW, *Editor*

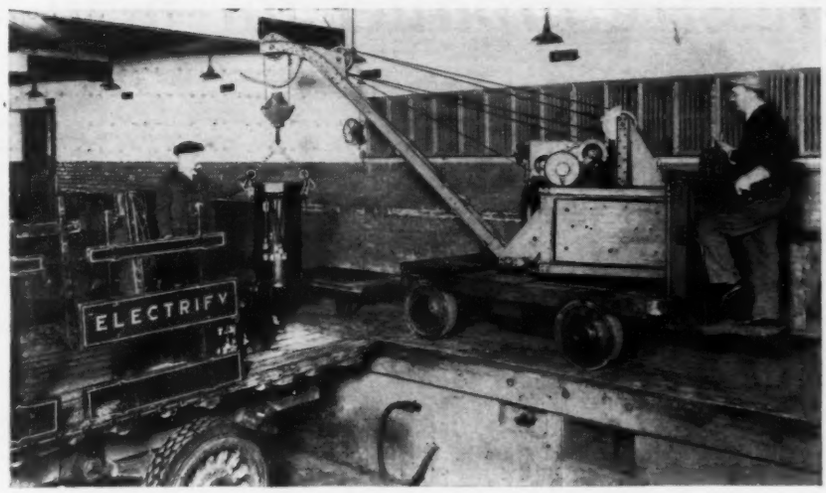
FRANK R. INNES
Western Editor
520 N. Michigan Ave.
Chicago

H. S. KNOWLTON
New England Editor
1427 Statler Bldg.
Boston

WALTER C. HESTON
Pacific Coast Editor
883 Mission St.
San Francisco

PAUL WOOTON
Washington
Correspondent
National Press Building
Washington

JAMES H. RUDD
Publishing Director



Electrical material handling Public Service of Northern Illinois

MARCH 5, 1932

Contents, Copyrighted, 1932, by McGraw-Hill Publishing Company, Inc.

VOLUME 99 . . . NUMBER 10

Ariel Hydro Development..... 442
By A. C. CLOGHER and W. S. MERRILL, *Electric Bond & Share Company.*

Steel Plants Have Regional Energy Potentialities 449
By DR. A. H. DYCKERHOFF, *Chicago*

Unemployment Committee Aids 696 Engineers in New York..... 452

Supervisory Control for Reading Electrification 454
By G. I. WRIGHT, *Reading Company*

Hydrogen-Cooled Condenser Reduces Operating Costs..... 458
By C. E. SCHNELL, *San Joaquin Light & Power Corporation*

News of the Industry.....425
Editorials 437
20-23% Lower Annual Charges for Network System..446
Control Circuit Terminal Boxes Serve Switchyard 447
Effect of Humidity on Insulator Flashover 448
Sunburn—Tan—Health 453
New Hampshire Utility Costs Analyzed 457
Electric Ovens Used to Sterilize Mattresses 461
Promoting Safety by Engineering Design.....462
Caution Needed in 3-Wire Services from 4-Wire Networks.463
Photo-Cells Protect Public from Power-Operated Doors...464
Readers' Forum 464
Men of the Industry 465
Trade Notes 467
New Equipment Available.....468

Electrical World articles are indexed in Industrial Arts and Engineering Indexes, available in public libraries

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

CHICAGO, 520 N. Michigan Ave. 883 Mission St., SAN FRANCISCO Aldwych House, Aldwych, LONDON, W.C. 2

JAMES H. McGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. McGRAW, JR., Vice-Pres. and Treas.
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
H. C. PARMELEE, Vice-Pres. and Editorial Director
HAROLD W. McGRAW, Vice-President
C. H. THOMPSON, Secretary

Published weekly. $5 per year. 25 cents per copy. Foreign, $9 U. S. currency, or 45 shillings, per year. Canada subscription price (including Canadian duty), $7.50. Entered as second-class matter, January 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

CABLE ADDRESS: "MCGRAWHILL, N. Y."

Member A.B.P. *Member A.B.C.*

NUMBER OF COPIES PRINTED THIS ISSUE, 16,660

WASHINGTON, National Press Building
PHILADELPHIA, 1600 Arch Street
CLEVELAND, 501 Guardian Building
DETROIT, 2-257 General Motors Building
ST. LOUIS, 1556 Bell Telephone Building
BOSTON, 1427 Statler Building
GREENVILLE, S. C., 1301 Woodside Building
LOS ANGELES, 339 Chamber of Commerce Building

OKOSHEATH
UNDERGROUND CABLE
a progressive product for new trends

As simple as a pencil

SUITABLE for installation in conduits or directly in the ground, Okosheath is a non-metallic sheathed cable for secondary networks, building services, parkway lighting, industrial plants, airports, recreation fields and other low voltage, underground distribution.

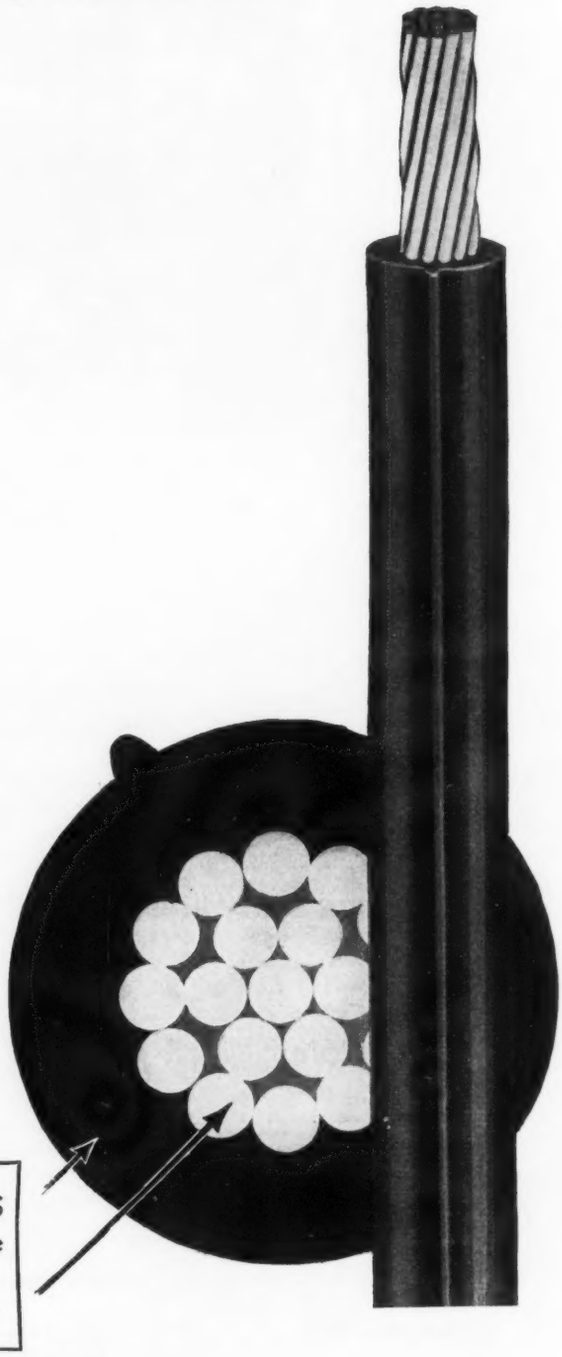
The construction of Okosheath Cable is simplicity itself, for this cable consists simply of the conductor and a special rubber sheath which serves both as insulation and mechanical covering. A lineman can splice it.

The specially treated rubber of the sheath is impervious to moisture and to earth acids and alkalies.

The favorable burn-off characteristics of Okosheath Cable make it particularly useful for secondary networks. Okosheath Cable is clean, smooth, flexible, easy to handle, bend and splice. Light in weight, small in diameter, requiring smaller reels, it saves freight and space.

Okosheath Cable has been produced in a progressive spirit to meet the new requirements of power distribution. Its possibilities are quickly being recognized by the Industry.

Samples of Okosheath Cable and prices will gladly be furnished upon request.



ONLY 2 PARTS
1.—The One-Piece Sheath
2.—The Conductor

THE OKONITE COMPANY
Founded 1878
THE OKONITE-CALLENDER CABLE COMPANY, INC.
Factories: Passaic, N. J. Paterson, N. J.
SALES OFFICES: NEW YORK CHICAGO PHILADELPHIA PITTSBURGH ST. LOUIS BOSTON ATLANTA SAN FRANCISCO LOS ANGELES SEATTLE DALLAS
Novelty Electric Co., Philadelphia, Pa. F. D. Lawrence Electric Co., Cincinnati, O.
Canadian Representatives: Engineering Materials, Limited, Montreal
Cuban Representatives: Victor G. Mendoza Co., Havana

ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

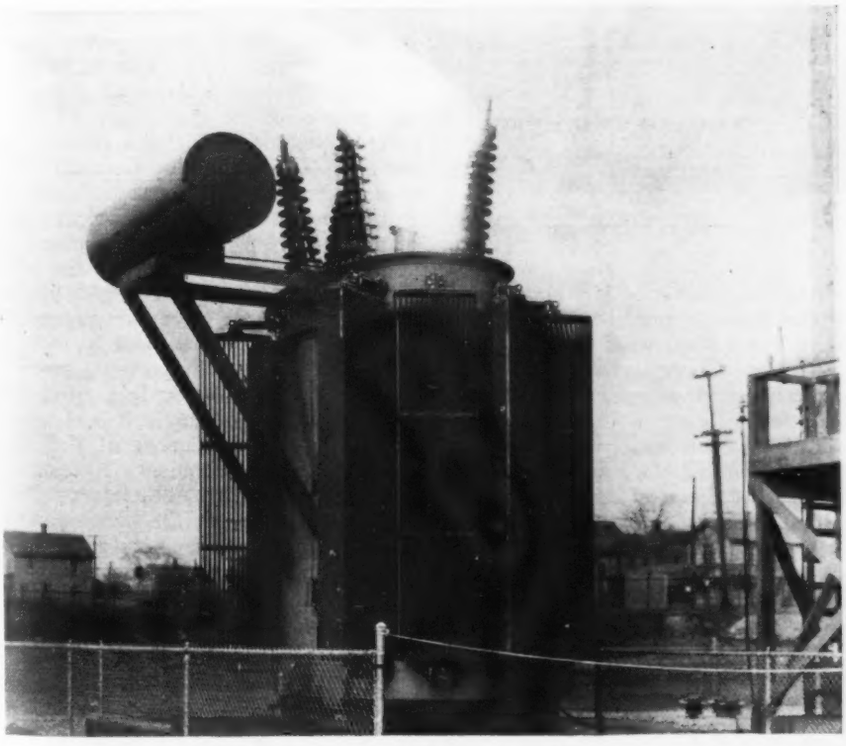
March 5, 1932

Niagara-Hudson board recommends capitalization cut

p. 431

F. L. Hutchinson, A.I.E.E. secretary, dies

p. 426



Surge tests applied to transformer while energized at 60 cycles

This 115-kv., 7,500-kva. power transformer successfully withstood a 1,000,000-volt surge while energized with 60-cycle normal voltage at the Sharon works of Westinghouse last week. Another step toward full assurance of equipment performance—*p. 437.*

—**Research honors are awarded** to Messrs. Coolidge, Langmuir and Faccioli by various organizations. Medals, awards and cold cash come to men whose dreams become practical—*pp. 428, 465.*

—**Supervisory control selected** for Reading railroad electrification because of flexibility, permissible clearance speeds, freedom from error and concentration of operations—*p. 454.*

—**How one district organized** for relief of unemployed professional engineers. New York has aided 696 men to date. About 15 per cent were electrical engineers—*p. 452.*

—**Ariel hydro project notable** for full use of river width for station foundation, for water cooling of concrete after pouring and for unusual provisions to protect spawning salmon—*pp. 441, 442.*

F. L. Hutchinson Dies from Heart Trouble

Secretary of A. I. E. E. had courageously stuck to his work through illness during winter convention activity.

STRICKEN with grippe two weeks before the winter convention of the American Institute of Electrical Engineers in the last week of January, arising from his sickbed to take part in the convention work and returning to it, worn out, on February 8, Frederick Lane Hutchinson, known personally to many hundreds and by name to all electrical engineers in the United States by virtue of his twenty years in the office of secretary of the association just named, died from heart trouble very early on Friday morning, February 26.

Mr. Hutchinson was born in Elizabeth, N. J., April 2, 1866. His career began in the service of the Pennsylvania Railroad Company in New York City, where he had several years' experience in accounts, correspondence and general office work. In 1889 he entered Cornell University, and he was graduated from the electrical engineering course in 1893, when he entered the employ of the Westinghouse Electric & Manufacturing Company. After several years' experience in the manufacturing, testing, engineering and sales departments in Newark, New York City and Pittsburgh, he was transferred to the publication department, where for several years he was employed in preparing the technical literature of the Westinghouse company.

In 1901 Mr. Hutchinson became manager of the publication department of the C. W. Hunt Company, New York, and in the following year advertising manager of the National Electric Company of Milwaukee. A year later he was made manager of electrical sales for the company last named.

In 1904 Mr. Hutchinson returned to New York and undertook some special work on the *Transactions* of the American Institute of Electrical Engineers. Gradually the scope of his work was increased until, in February, 1908, upon recommendation of Secretary Ralph W. Pope, he was appointed assistant secretary. Upon Secretary Pope's resignation after 27 years of service with the Institute, Mr. Hutchinson was, in August, 1911, appointed acting secretary by the board of directors. On January 12, 1912, the board of directors of the Institute unanimously appointed him national secretary.

Mr. Hutchinson became an associate of the Institute in 1894 and was transferred to the grade of member in 1913. He was thoroughly familiar with the history and policies of the Institute, the scope and duties of its numerous committees and representatives and the relations of the Institute to other engineering and similar organizations, both in this country and abroad. He was one of the delegates of the Institute to the World Power Conference in London, 1924, and to the World Engineering Congress, Tokyo, 1929. He served as a member of various Institute committees both before and after he became secretary. Immediately prior to his death he was a member of committees having supervision of several important activities, including publications, coordination of Institute activities, award of the Edison Medal and maintenance of

Frederick L. Hutchinson

Institute headquarters. Mr. Hutchinson also was a representative of the Institute on the assembly of the American Engineering Council, the division of engineering and industrial research of the National Research Council and the Engineering Societies library board. He was an enthusiastic worker for the development of the engineer and for the enhancement of the engineering profession and was identified with various joint endeavors of the national engineering societies and allied organizations the efforts of which were directed toward that end.

At the time of Mr. Hutchinson's appointment as secretary the Institute had little more than one-third of its present membership, and its rapid growth and increasing activities made growing demands upon the secretary's office, in meeting which Mr. Hutchinson displayed marked executive ability. He combined a very pleasing personality with a highly judicial temperament. With characteristic energy he mastered every phase of the Institute's activities and won the confidence of all with whom he dealt. He was a distinguished type of the accomplished and essential permanent secretary who, while officers come and go, keeps the wheels of administration running smoothly and enables his association to continue its work without confusion or interruption.

Mr. Hutchinson was a member of the American Association for the Advancement of Science, the American Sociological Society and the American Academy of Political and Social Science. He leaves a wife and two stepsons.

▼

Doherty Gas Company Loses Interstate Case

In dismissing the appeal of the Western Distributing Company in a gas-rate controversy with the Kansas Public Service Commission, the United States Supreme Court took the position this week that it is within the right of state regulatory bodies to consider the reasonableness of contracts with interstate distributing agencies in determining a retail rate basis. The Kansas case had its inception in the application of the Western Distributing Company for an increased rate in Eldorado. In submitting its cost figures, on the basis of which it claimed that it was incurring a loss, the Western Distributing Company showed that one of its largest items of expense is the amount that it pays to the Cities Service Company for natural gas purchased at the city line. The company admitted financial relationship with the Cities Service Company, but refused to permit the commission to make the cost of the purchased gas part of the proceedings in the rate case. In taking this position the company contended that the rates charged by the pipe-line company are for interstate service and are not subject to indirect regulation by the state commissions.

After the commission had refused to grant any increase until it had ascertained the reasonableness of the purchase contract the company took action in the federal courts. The lower federal tribunals dismissed the suit on the ground that the company had not availed itself of all of the opportunities held out by the commission. In sustaining the lower courts, the Supreme Court makes reference to the "affiliation of buyer and seller and the entirety of the contract thus engendered." After pointing out that "those in control of the situation have combined the interstate carriage of the commodity with its local distribution in what is in practical effect one organization," the Supreme Court determines that the lower courts were correct in holding that the reasonableness of the contract should enter into a determination of the retail rate.

Consolidated Gas Makes Floyd Carlisle Chairman

Election of Floyd L. Carlisle, chairman of the New York Edison Company's board of directors, to the same position with the parent organization, the Consolidated Gas Company, was announced on Friday of last week. The chairmanship of Consolidated Gas had remained unfilled since 1914, when it was resigned by the late Harrison E. Gawtry. Mr. Carlisle's election is thought to be the logical sequence both of his own rapid advancement in the New York Edison ranks, of which he was first elected a director less than two years ago, and of the close relationship now existing between the metropolitan associated electric companies and the Niagara-Hudson Power Corporation, of which also Mr. Carlisle is chairman, with its state-wide group of large operating subsidiaries.

Mr. Carlisle, however, discouraged speculation on the possible unification of the two great systems by declaring: "My election has no significance outside of the Consolidated Gas family." A portrait and a biographical sketch of Mr. Carlisle (long a power in upstate light and power doings) were printed as a frontspiece feature in the ELECTRICAL WORLD of April 18, 1931.

▼

Albany Democrats Introduce Utility-Control Bills

A series of seven bills representing the Democratic policy as to public utility supervision and regulation were introduced in the New York Assembly on Wednesday by Irwin Steingut, minority leader. One amends the public service law by changing the definition of "affiliated interests" to include holding of 5 per cent of voting capital stock of a utility corporation, instead of 10 per cent as at present, provided that no charge for management or construction or similar service shall exceed reasonable cost of performing such service, and making other changes; a second adds a new section to permit municipalities and group consumers to appear at any hearing or proceeding involving rates or service; a third adds a new section providing that the commission shall not approve rates yielding in excess of a reasonable return and defining such reasonable return; a fourth empowers the commission to require issues or sales of stocks, bonds or notes to be by public bidding after notice. The other three bills offer different plans to establish rates by contract for certain types of public service.

Senator John A. Hastings has introduced a bill requiring all gas, electric and telephone companies to file new rates before July 1 showing a 10 per cent reduction under the rates of January 1, 1932, and directing the commission to start proceedings against each corporation which fails to do so.

▼

New Beauharnois Rules Formulated at Ottawa

A new order-in-council has been proclaimed by the Canadian government setting forth the conditions under which the Beauharnois Light, Heat & Power Company may proceed with its great power project on the St. Lawrence River between Lake St. Francis and Lake St. Louis. The diversion of 53,072 sec.-ft. from the St. Lawrence under a 75-year lease given by the Quebec government is authorized, but it is stated clearly that in future the Governor-in-Council will no longer have the right to extend this diversion.

In other words, the Dominion government has declared that the consent of Parliament will be required if further additional diversion is sought. With the proclamation of the order-in-council, the government automatically takes over the twenty-million-dollar canal which will be one of the navigation links in the ultimate St. Lawrence waterway. Another clause leaves the question of rights over the power open. If the government desires to refer the question of ownership of power as between the Dominion and the Province of Quebec to the Supreme Court of Canada, the whole matter can be reopened.

▼

Trade Commission Faces Reduced Appropriation

In approving the independent offices appropriation bill for the next fiscal year, the House appropriations committee has not sought to reduce the amounts available for the power investigation by the Federal Trade Commission and for the Federal Power Commission, although other appropriation bills reported out by the committee this session have been reduced lower in every case than the estimates made by the Bureau of the Budget. This bureau recommended a reduction of $512,266 in the total appropriation for the Federal Trade Commission, and the House committee has accepted this recommendation and made the total appropriation for that commission $1,266,000.

Chairman Humphrey of the Federal Trade Commission is quoted as saying that if the deduction is sustained by Congress, about 180 employees will have to be dismissed and a number of investigations now under way will have to be dropped.

Steel Outlook Better; Confidence Rises Slowly

UNREASONED pessimism gradually but very reluctantly gives way to slowly reviving confidence. The most potent deterrent to revival at this stage arises from hysterical predictions by pessimists.

How far liquidation has proceeded may be gaged by various factors, such as wholesale commodity prices, which, "Bradstreet's" states, have reached a low point since the last year of the nineteenth century. Writing down of portfolios by leading utility and industrial concerns reflects a healthy willingness to recognize the degree of deflation that has already taken place.

In the steel industry ingot production is 26 per cent of capacity. A slight advance is reported in steel-mill activity and in pig-iron output. Steel men anticipate acceleration of the increase in demand initiated by certain branches of the automobile industry.

Other definitely favorable factors include a sharp reduction in bank closings, a moderate flow of currency back to the banks, advances in government bonds, reductions in wage rates of railway and building trade employees, some increase in new financing operations and a definitely improved situation abroad.

Japan's Electrical Men Appeal to Confreres Here

Through the New York offices of Mitsui & Company a defense of Japan's military activities in Shanghai was sent on March 1 by six Japanese national electrotechnical and allied associations to the National Electric Light Association, the American Institute of Electrical Engineers, the American national committee of the World Power Conference and "other associations and people connected with the electrical industries in the United States."

The statement, framed by Count Keigo Kirouya, former Premier of Japan, says that the senders "have seen with pain and surprise that a considerable section of opinion in the United States has already come to the settled conclusion that the recent actions of Japan in Shanghai are indisputably blameworthy and deserving of reprobation." Declaring that they love peace equally with their American confrères, the electrical men assert that the movement of Japan against Shanghai is one in self-defense, that the Chinese brought about the hostilities, that Japan wants no Chinese territory and is for the "open door," that China is in a state of chaos and not a coherent nation, and that tales of Japanese atrocities are fiction. American engineers are entreated to give Japan's side of the quarrel due consideration in the interest of international friendship and world peace.

WASHINGTON AWARD GOES TO W. D. COOLIDGE

—*Wide World Photos*

Frank D. Chase, president Western Society of Engineers, hands the Washington award for 1932 to Dr. W. D. Coolidge, associate director General Electric research laboratory. The presentation took place at a dinner in the Hotel Sherman, Chicago. **(See page 465.)**

▼

Merchandising Accounting Again Discussed in Oregon

Continuation of the hearing before the Oregon Public Utilities Commissioner of the two-year-old complaint of the Merchants' Utility Bureau of that state against merchandising accounting practices of electric and gas utility companies took place in Salem on February 16 (ELECTRICAL WORLD, February 13, page 295). In this second hearing the complainants' case was confined specifically to accounting practices, and very little evidence pertaining to merchandising practices as followed in the field was introduced.

An expert accountant for the petitioners attempted to show that merchandising losses were reflected in the rates of the companies in a manner unfavorable to the public. This the companies denied. Petitioners also produced a suggested outline of accounting procedure for merchandising and jobbing departments of the utility companies, and this outline was taken under advisement by the commissioner and by the companies. The companies introduced some general evidence of the favorable effect past merchandising activities had had in lowering rates. V. H. Moon, sales manager Pacific Power & Light Company, Portland, the only witness for the companies, testified concerning the merchandising policies his company had put into effect for the purpose of encouraging independent electrical dealers.

A final order from the commissioner on a new classification of accounts for merchandising operation is expected within a month.

▼

Anti-Merchandising Moves in Various Commonwealths

West Virginia, Colorado, Wisconsin, Oregon, Massachusetts and Virginia Among States Agitated

Resolutions opposing the retailing of appliances by utility companies have been passed recently in two more states —West Virginia and Colorado—by conventions of hardware dealers. The West Virginia Hardware Association called the practice "unfair under existing conditions." The Mountain States Hardware and Implement Association appointed a committee to help promote legislation prohibiting merchandising.

The Slagg anti-merchandising bill, introduced in the closing days of the Wisconsin Legislature last year, is to be again brought forward in that state, it is said. This bill provided that on a second offense the offending utility should forfeit its charter. None the less, adjustment of problems of competition between hardware dealers and electric and gas companies selling appliances was discussed recently at the annual convention of the Wisconsin Retail Hardware Dealers at Milwaukee. Utility representatives met with the hardware dealers in an effort to agree on a plan of co-operation which would include uniform prices for appliances at hardware stores and utility salesrooms. Dealers spoke very favorably of their relations with utility companies and of the marked improvement in sales following co-operation with the latter.

Unless the Oregon Utility Commissioner can arrive at some conclusion which will tend to satisfy the independent dealers in domestic electrical and gas appliances in that state, the dealers will, they say, inaugurate a campaign for an initiative law which will prohibit marketing of gas and electrical appliances by public utilities. This ultimatum has been delivered to the utility operators by the Oregon Merchants' Utility Bureau following hearings before the commissioner in which the utilities' accounting methods came in for overhauling. The second of these hearings is noted under another heading on this page.

Legislation designed to prohibit gas and electric companies from engaging in the retail sale of appliances was vigorously opposed before the power and light committee of the Massachusetts General Assembly last week by representatives of organized labor, public utility companies and manufacturers.

GOLD MEDAL AND $10,000 TO IRVING LANGMUIR

—*Wide World Photos*

From the "Popular Science Monthly" the associate director of the General Electric research laboratory has just received the above reward for his achievements in the electric lamp, vacuum-tube and arc-welding fields. Dr. F. B. Jewett (right) was chairman of a distinguished committee which made the award.

▼

The Appalachian Electric Power Company, the Insull companies and other public utilities operating in various sections of Virginia will be asked to follow the lead of the Virginia Electric & Power Company and discontinue sales competition with hardware merchants. This request was embodied in formal resolutions adopted by the Virginia Retail Hardware Association, meeting in Richmond last week. The Virginia Electric & Power Company discontinued on March 1 the sale of electric refrigerators and smaller appliances in Richmond, Norfolk and Portsmouth, according to an announcement by President J. G. Holtzclaw, and the order ultimately will be extended to all communities in the company's system. The company will continue the sale of electric ranges and water heaters.

▼

Ohio Considers Increased Taxation on Her Utilities

A special session of the Ohio Legislature, which assembled on March 1 at the call of Governor George White to raise $31,000,000 for state relief to the unemployed, will, at the Governor's suggestion, consider heavily increased taxation on public utilities of all kinds. Taxes on electric light and power companies under the plan contemplated would be increased 1.35 per cent.

Indianapolis Rate Cut Still Loudly Demanded

Reconsideration of a petition for a reduction in light and power rates in Indianapolis will be requested of the Indiana Pubic Service Commission by the petitioners on the ground that the commission's action in dismissing the request without a hearing, audit, appraisal or sworn testimony—the commission insisting that a valuation of the company's property would involve expense and bring no decrease in rates—was contrary to law. The demands upon the Indianapolis Power & Light Company for lower rates have become clamorous, both afternoon papers helping to sustain the agitation.

A novel bond for $200,000 posted by the Indianapolis Power & Light Company as a guarantee that it would not raise rates during a five-year period expiring in January of this year has been withdrawn from the depositary. The agreement provided that if the company made any effort to increase rates during the stipulated period the bond could be sold to provide the Chamber of Commerce with funds to fight the attempt.

Mayors and other city officials from Indiana cities met last week at Martinsville and pledged aid in changing or repealing the state's commission law. Both political parties will be asked to state their position. A permanent organization based on hostility to the utility companies was formed.

▼

Oregon Commissioner on Federal Court Rate Cases

Oregon's Utility Commissioner, Charles M. Thomas, has made public a statement in which he claims the universal support of the various other state utility commissions in the United States for his movement to deny the federal courts jurisdiction in matters pertaining to the authority of the states to regulate their utilities. Commissioner Thomas initiated this campaign against federal court rate verdicts after an adverse report of a referee appointed to review an order of the commissioner which reduced street car fares in Portland from 10 cents to 7 cents had been rendered. Such court action, Mr. Thomas maintains, amounts to the "strangulation of regulation."

"Under such a situation," he says, "the commission finds itself in a position where if it holds long and expensive hearings and makes its record, then an aggrieved utility may completely evade such record by seeking sanctuary in the lower federal court, where such record is not only denied consideration but denied admittance as evidence. On the other hand, if the commission fails to make a record sufficient to justify and sustain its order, then the aggrieved utility can appeal to the state courts, where the trial is based upon the record of the commission, and if the record is found insufficient, the order will be declared invalid. The effect of all this is that state regulation is a farce if the utilities desire to make it so."

Senator Johnson of California has introduced a bill covering the matter which is acceptable to Commissioner Thomas (ELECTRICAL WORLD, February 6, page 253).

▼

Small Purchased Units Make up Florida Power

Three sessions of the Federal Trade Commission's investigation into the utility companies were devoted on February 24-26 to the Florida Power Corporation originally set up in 1899 as the St. Petersburg Electric Light & Power Company and acquired in more recent years by A. E. Fitkin & Company and then by the Insull interests. It has had several other names and is now controlled, at four removes, by the Middle West Utilities Company. It represents, Examiner Hughes testified, about 40 former small private and municipal plants in west and central Florida. The Florida Power's capital grew from $1,000,000 in 1920 to more than $21,000,000 in 1930, it was testified.

Mr. Hughes traced various of the plant-purchasing transactions in which the company had participated. At the end of 1930, he said, the company was carrying in its fixed capital account an excess of $1,000,000, representing abandoned or obsolete property prior to 1926 which had not been written off for the reason that there was an insufficient reserve for this purpose

The examiner added that the use of a rate that would have set up a sufficient amount in the reserve account would have prevented the paying of any dividend on the common stock during 1927 and subsequent years and would have reduced considerably the dividends of $887,559 paid in 1926. A particular condition in connection with Florida Power that required the setting up of a depreciation reserve that might be considered in excess of a normal amount is that so many of the purchased small plants have had to be renovated, remodeled or rebuilt in order to consolidate them with the main system. The cost of these properties in many instances, Mr. Hughes said, exceeded their physical value based on inventory.

When the commission resumes its hearings on March 9 the Nebraska Power Company, an American Power & Light property supervised by the Electric Bond & Share Company, will come up for review.

Coming Meetings

Oklahoma Utilities Association—Tulsa, Okla., March 8 and 9. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Pacific Coast Electrical Association — Engineering and Purchasing and Stores Sections, Fresno, Calif., March 9-11; Commercial Section, Santa Cruz, Calif., March 17 and 18. K. I. Dazey, 447 Sutter St., San Francisco.

American Institute of Electrical Engineers—District meeting, New Pfister Hotel, Milwaukee, March 14-16; Providence, May 4-7. Acting secretary, 33 West 39th St., New York.

National Electric Light Association — Group committee meetings, Commercial National Section, Edgewater Beach Hotel, Chicago, March 22-24. A. J. Marshall, 420 Lexington Ave., New York.

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 8. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

New England Division, N.E.L.A. — Engineering Section, Boston, March 3 and 4; safety conference, Boston, April 8. Miss O. A. Bursiel, 20 Providence St., Boston.

Great Lakes Division, N.E.L.A.—Engineering Section, Sherman Hotel, Chicago, April 13 and 14. R. G. Walter, Wisconsin Power & Light Co., Madison, Wis.

Northwest Electric Light and Power Association — Engineering Section, Heathman Hotel, Portland, April 13-15; H. H. Schoolfield, Pacific Power & Light Company, Portland. Accounting Section, Davenport Hotel, Spokane, Wash., April 18-19; W. F. Miller, Washington Water Power Company, Spokane.

Arizona Utilities Association—Tucson, Ariz., April 13-15. J. S. Arnold, Central Arizona Light & Power Co., Phoenix, Ariz.

Electrochemical Society — Lord Baltimore Hotel, Baltimore, April 21-23. C. G. Fink, Columbia University, New York.

Southwestern Division, N.E.L.A. — Arlington Hotel, Hot Springs, Ark., April 25-28. S. J. Ballinger, San Antonio Public Service Co., San Antonio.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 28-30. Jesse Blythe, 103 West High St., Jefferson City, Mo.

National Fire Protection Association—Atlantic City, N. J., May 9-12. A. R. Small, 109 Leonard St., New York.

Middle West Division, N.E.L.A. — Muehlbach Hotel, Kansas City, Mo., May 18-20. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

East Central Division, N.E.L.A.—Commodore Perry Hotel, Toledo, Ohio, May 24-27. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electric Light Association — Atlantic City, N. J., June 6-10. A. J. Marshall, 420 Lexington Ave., New York.

▼

South Carolina Solons Fight Over Power Bill

Strong opposition to the passage of the bill regulating electric power rates in South Carolina (ELECTRICAL WORLD, February 20, page 340) was indicated in the House of Representatives of the General Assembly February 28 in a preliminary skirmish which had to do with sending the bill introduced by the judiciary committee back to that committee. The bill was finally sent back for further discussion. An unfavorable majority report had been given to this bill by the judiciary committee, with the minority favorable.

The bill will probably come up for debate in the House next week.

WELDING OIL-STORAGE TANKS IN THE FIELD

This 20,000-barrel tank at Corpus Christi, Tex., and others four times its size have been arc-welded by the Lincoln Electric Company process, using a home-made truck derrick, a mobile welding machine and a traveling scaffold cage.

▼

Regulatory Issues Before Chief Wisconsin Court

Indeterminate-permit law upset — Commission order awaits ruling — Chamber fights debt-limit waiver

Wisconsin's regulatory law providing for operation of public utilities under indeterminate permits was in part overturned by a recent decision of the State Supreme Court, which ruled that such a permit does not apply in a town area outside of municipal limits. The decision reversed a holding of the Dane County Circuit Court, which affirmed an order of the commission directing the South Shore Utility Company to discontinue serving the village of Combined Locks, in which the Kaukauna municipal utility claimed an indeterminate permit, the higher court describing the order as unreasonable and unlawful.

"If the effect of this decision is to place towns in a field where a free-for-all rendering of utility service by different public utilities may be permitted, we can only say that such is the effect of the law as it exists," the court observed. Neither the Kaukauna plant nor the Wisconsin-Michigan Power Company, it held, was operating in Combined Locks under an indeterminate permit and no declaration by the commission of public convenience and necessity was required to enable that village to grant a franchise to the South Shore Utility Company.

Arguments on a ruling by the Wisconsin Public Service Commission denying a public utility the right to issue securities on property financed by consumers were formally presented to the Wisconsin Supreme Court on February 13. The commission's ruling was directed at the Wisconsin Hydro-Electric Company, which appealed the decision to the courts. Although the case only involves approximately $12,000, a decision will affect hundreds of thousands of dollars in securities throughout the country, David Lilienthal, commissioner, said. He contended that property financed by consumers would have two claims for returns against it if securities were issued, namely, the claim of the security holders for a return on their investment and the claim of consumers who financed the property for a return on the capital contribution through an offset in their rates.

The constitutional amendment to be voted on next November which would exempt from the debt limitation of municipalities obligations incurred to acquire, build or operate public utilities, such obligations to be secured solely by the property or income of such utilities, is being strongly opposed by the Wisconsin Chamber of Commerce.

▼

Trade Relations Is Theme at Portland Meeting

Real progress in promoting better trade relations in the Pacific Northwest was manifest throughout a well-attended three-day meeting of the Commercial Section, Northwest Electric Light and Power Association, held at Portland, Ore., February 18-20. Especially was this evident from reports and discussions presented by the Merchandise Bureau under the chairmanship of R. B. McElroy. Few reports were read at the sessions, which were notable for the participation of the younger men. President P. M. Parry of the association said that a high degree of saturation combined with low rates has now made the initial cost of appliances the chief obstacle to sales. G. M. Gadsby, regional director, stressed the necessity for the utility taking the lead, past experience showing that where the utility was not active a poor job was likely to be done.

The outstanding accomplishment of the Commercial Section this year was the work of the Merchandise Bureau, whose whole program was built around relations with dealers. A survey showed that all utilities are now in close agreement as to practices and policies and that all are making excellent progress in eliciting co-operation of dealers in developing the tremendous unsold market that exists.

It was again decided to forego the annual convention, which had been scheduled for Salt Lake City in June. Instead, a meeting of class A members will be held for closing the year's business.

▼

New York Ranks Second in Rural Electrification

D. E. Blandy, chairman of the Farm Electrification Council, a New York State organization, told the members at a meeting held recently in Syracuse that the number of county transmission lines in use in the state has more than doubled within the last five years and now stands at approximately 20,000 miles. From these lines more than 50,000 farms are served with high-quality electric service at rates generally the same as those effective in nearby urban centers. This makes New York State second only to California in the number of farms using electric service. "The one obstacle in the path of still further use of electricity on the farms of the state," said Mr. Blandy, "is inability of farmers to finance the purchase of equipment which they know will be wealth-producing."

An interesting development was reported by C. H. Churchill, general manager of the Cortland County Traction Company, who, noticing that the bill of a dairyman customer had materially increased, visited the farm to discover the reason and found that the dairyman had himself invented an electrical scalding device with which he was greatly pleased. Since then the use of electrical scalding devices has spread over the whole state, Mr. Churchill said.

Attending the meeting were members of the New York State College of Agriculture and of Cornell University, manufacturing and utility experts and spokesmen for farmers.

Insull Companies' Expenditures Will Be Small

At meetings of the stockholders of the Commonwealth Edison Company and the Public Service Company of Northern Illinois held February 29 Samuel Insull, chairman of both companies, announced that capital expenditures during the current year would be small. Mr. Insull stated that expenditures in previous years had made the facilities of the corporations adequate for present needs and that little new financing by either of the companies could be expected.

At the meeting of the Commonwealth Edison Company Sewell L. Avery, president of the United States Gypsum Company and chairman of the board of Montgomery Ward & Company, was elected a director to fill the vacancy caused by the death of Henry A. Blair. At the meeting of the Public Service Company B. E. Sunny and Stanley Field were elected to the positions on the board formerly held by Mr. Blair and William A. Fox.

▼

Niagara Hudson Plans to Reduce Capitalization

Following the announcement last week by Electric Bond & Share Company directors that a reduction of capitalization is planned, the Board of Niagara Hudson Power Corporation has approved a similar plan to reduce the number of common shares outstanding by two-thirds. Stockholders will vote on the proposal April 12.

This plan provides for the reduction of the 27,771,035 outstanding common shares of $10 per value to 9,257,011 shares of $15 par value shares. This constitutes a two-thirds reduction in the number of shares, but a reduction of only 50 per cent in the stated value of all shares. As a consequence, $138,855,175 is to be transferred from the present capital, which is given on the books of the company as $277,710,350, to surplus and reserve account in proportions to be announced later.

If this proposal is ratified by the stockholders it will have a bearing upon the option warrants of the company outstanding in the following proportions:

The 8,848,592 class A warrants, each entitling the holder to purchase one share of common stock at $35 until October 1, 1944, will be exchanged for 2,949,531 class A warrants, each entitling the holder to buy one share of new common stock for $105 until October 1, 1944.

The 495,620 class B warrants, each entitling the holder to purchase three and a half shares of common stock for $50 perpetually, will be exchanged for 165,266 class B warrants, each entitling the holders to buy 3½ shares of new common stock perpetually for $150.

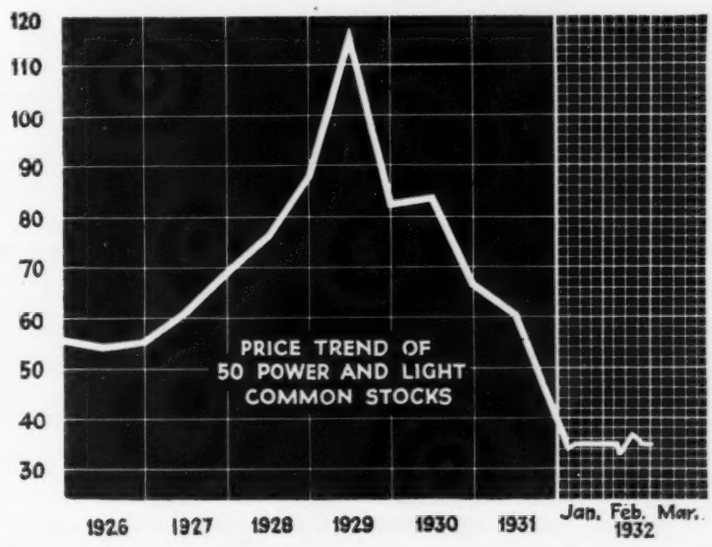
The 2,265,000 class C warrants, each entitling the holder to purchase for $25 one share of common stock and one-third class A warrant until December 2, 1934, will be exchanged for 755,000 class C warrants, each entitling the holder to buy for $75 one share of new common and one-third new class A warrant until December 2, 1934.

The annual report of the company for 1931 shows that operating revenues of the corporation and subsidiaries during 1931 amounted to $77,449,120, against $78,833,540 in 1930. Operating income was $32,392,681, against $36,800,762 for 1930. A radical reduction in operating cost more than offsets the decline in earning.

▼

Bond Prices Up; Stocks Down

While the trend of bond prices in general has been upward during the past month changes in utility bond quotations have been decidedly mixed. The net result is a rise of less than one point in the average, from the low of 92.1 at the beginning of February.



Utility common stock prices have receded fractionally, but averages remain virtually unchanged. Pressure on some of the Insull stocks brought quotations down further this week.

Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Birmingham Electric					
(Year ended December 31)					
Gross earnings	$7,343,181	$8,240,160	—11.0	69	69
Net earnings	2,283,116	2,538,732	—10.0	..	..
Carolina Power & Light					
(Year ended December 31)					
Gross earnings	9,796,345	8,904,205	10.0	50	45
Net earnings	4,849,945	4,942,654	— 2.0	..	..
	1932	1931			
Detroit Edison					
(Year ended January 31)					
Gross earnings	48,814,927	52,983,006	— 7.9	65	68
Net earnings	17,275,744	16,869,192	2.4	..	..
	1931	1930			
Eastern Texas Electric					
(Year ended December 31)					
Gross earnings	9,278,042	10,173,631	— 8.9	60	60
Net earnings	3,726,222	4,089,464	— 8.9	..	..
Gulf States Utilities					
(Year ended December 31)					
Gross earnings	6,354,347	7,100,667	—10.5	56	57
Net earnings	2,783,123	3,077,295	— 9.6	..	..
Houston Lighting & Power					
(Year ended December 31)					
Gross earnings	8,567,692	8,789,687	— 3.0	46	52
Net earnings	4,609,958	4,195,899	10.0	..	..
Idaho Power					
(Year ended December 31)					
Gross earnings	4,344,870	4,153,121	5.0	48	48
Net earnings	2,236,492	2,168,595	3.0	..	..
Louisiana Power & Light					
(Year ended December 31)					
Gross earnings	6,151,524	6,113,273	1.0	50	63
Net earnings	3,076,447	2,892,784	6.0	..	..
Memphis Power & Light					
(Year ended December 31)					
Gross earnings	6,904,791	6,821,058	1.0	58	59
Net earnings	2,896,789	2,807,711	3.0	..	..
Minnesota Power & Light					
(Year ended December 31)					
Gross earnings	6,091,539	6,479,225	— 6.0	37	39
Net earnings	3,826,039	3,977,598	— 4.0	..	..
Mississippi Power & Light					
(Year ended December 31)					
Gross earnings	$4,999,534	$5,066,892	— 1.0	62	65
Net earnings	1,876,731	1,740,957	8.0	..	..
Montana Power					
(Year ended December 31)					
Gross earnings	8,737,742	10,147,086	—14.0	40	40
Net earnings	5,211,066	6,142,584	—15.0	..	..
Nebraska Power					
(Year ended December 31)					
Gross earnings	6,809,599	6,603,262	3.0	47	49
Net earnings	3,598,315	3,368,510	7.0	..	..

OPERATING COMPANIES

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Nevada-California Electric					
(Year ended December 31)					
Gross earnings	5,650,825	5,672,386	— 0.4	48	48
Net earnings	2,909,771	2,968,162	— 1.9	..	..
New Orleans Public Service, Inc.					
(Year ended December 31)					
Gross earnings	17,357,426	17,646,557	— 2.0	64	65
Net earnings	6,350,467	6,284,137	1.0	..	..
Pennsylvania Power & Light					
(Year ended December 31)					
Gross earnings	34,982,510	31,006,433	13.0	49	50
Net earnings	18,012,856	15,706,772	15.0	..	..
Puget Sound Power & Light					
(Year ended December 31)					
Gross earnings	15,765,898	17,056,347	— 7.6	54	55
Net earnings	7,287,882	7,700,766	— 5.3	..	..
Southern California Edison					
(Year ended December 31)					
Gross earnings	40,715,934	41,128,734	— 1.0	30	32
Net earnings	26,999,818	28,082,407	— 4.0	..	..
Texas Electric Service					
(Year ended December 31)					
Gross earnings	8,283,470	9,087,510	— 9.0	47	48
Net earnings	4,348,058	4,706,391	— 8.0	..	..
Texas Power & Light					
(Year ended December 31)					
Gross earnings	9,978,163	9,959,631	0.0	49	49
Net earnings	5,123,152	5,064,484	1.0	..	..
Virginia Electric & Power					
(Year ended December 31)					
Gross earnings	16,957,180	17,150,297	— 1.1	54	55
Net earnings	7,779,655	7,660,131	2.5	..	..
Washington Water Power					
(Year ended December 31)					
Gross earnings	8,773,299	9,505,695	— 8.0	47	44
Net earnings	4,629,874	5,351,808	—13.0	..	..

HOLDING COMPANIES

Columbia Gas & Electric & Subs.					
(Year ended December 31)					
Gross earnings	89,404,033	96,129,808	— 7.0	50	50
Net earnings	44,443,062	48,107,457	— 7.6	..	..
	1932	1931			
Commonwealth & Southern & Subs.					
(Year ended January 31)					
Gross earnings	129,172,883	140,635,674	— 8.2	46	49
Net earnings	69,512,712	72,252,316	— 3.8	..	..
Public Service Corporation of New Jersey & Subs.*					
(Year ended January 31)					
Gross earnings	136,557,310	138,542,498	— 1.4	67	68
Net earnings	45,525,320	43,937,399	3.6	..	..

*Operating expenses include depreciation.

▼ ▼ ▼

Bargain Day Method of Selling Securities

In the early days of the public utility industry it was the fashion to call an offering of bonds, notes or stock an underwriting. A typical underwriting of the day was something like this:

$1,000—6 per cent 1st mortgage gold bond
500—7 per cent cumulative preferred stock
500—common shares
} Price $980 per block

This group or block gave the purchaser a yield of 9.4 per cent on his investment.

It was necessary in those times, when utilities were not so well known and their inherent stability was so little recognized, to offer special inducements even in selling the highest grade of first mortgage bonds in order to secure the necessary funds for financing improvements and extension. That was the reason for offering units consisting of a bond and various classes of stock.

Of course the offering of warrants to buy common stock, attached to a bond issue, has been widely practiced. But one company, the Utilities Power & Light Securities Company, has gone a step farther back toward the old policy referred to and is offering a block consisting of a debenture, preferred stock and common stock, of which the current market is slightly over $1,000 for the block. The yield at these prices is 11.1 per cent on the investment as a whole.

▼

Utility Financing in February Light

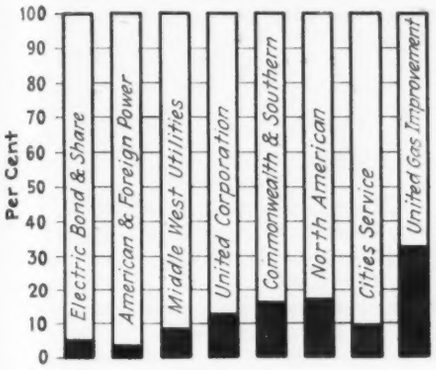
NEW public offerings by the electric light and power public utility companies of the country amounted to $26,500,000 during the month of February, as compared with $34,300,000 in January and $27,500,000 in February, 1931. A glance at the accompanying table shows that only two issues appeared, one of which accounted for $25,000,000 of the total.

Although representative bonds held their own, the gain in prices of listed issues was not substantial enough to encourage the offering of new issues.

An interesting feature of the month was the financing undertaken by the Associated Gas & Electric Company, described in detail in the February 27 issue of the ELECTRICAL WORLD. The offering was in the form of guaranteed 8 per cent eight-year gold bonds and amounted to $40,000,000. This offering was not included in the accompanying tabulation because it was not a public issue, but an offering to the company's security holders.

Name of Company	Amount of Issue (Par Value)	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Brooklyn Edison Co., Inc.	$25,000,000	20	General mortgage gold bonds, Series E	To reimburse for capital expenditures	5	97	5.25
Central Illinois Public Service Co.	1,500,000	25	First mortgage bonds	To reimburse for cost of additions and extensions	6	88	7.02
Total	$26,500,000			Rights	$2,000,000		
Total amount actually realized	25,570,000			Total financing	$27,570,000		

STOCK VALUES FRACTION OF 1929 HIGH



Current deflated values of group of utility stocks in relation to pre-depression prices

▼

Survey Reports Lower January Output

Public utility plant output in January was 7 per cent less than it was a year ago, the U. S. Geological Survey reports. The total was 7,401,000,000 kw.-hr., against 7,947,000,000 kw.-hr. for the corresponding month in 1931; the latter, in turn, was 8 per cent less than in 1930.

The average daily production in January was 238,700,000 kw.-hr., about 5 per cent less than the average daily production in December, but the average daily production from water power was 12 per cent greater. For the second consecutive month there was a large increase in hydro-electric output. This reflects the general increase in precipitation and the ending of the drought conditions which have continued for about two years.

One effect has been to reduce the fuel consumption by large amounts—by more than 100,000 tons of coal in December compared with November and by a further 300,000 tons in January. The latter is a cut of 10 per cent. Oil and natural gas consumption were similarly affected.

Regionally the decreased output in the eastern part of the country during the past three months compared with last winter is to be noted. Production was low also in the Mountain States. These regional losses reflect in part the state of the heavier power consuming local industries, but in part they were probably caused by unusual weather. Meanwhile gains are shown in the West North Central and South Atlantic States.

Per Cent Change in Output from Preceding Year

	November	December	January
United States	—4	—4	—7
New England	—5	—7	—9
Middle Atlantic	—2	—3	—13
East North Central	—6	—8	—6
West North Central	0	+5	+4
South Atlantic	+2	—3	+5
East South Central	—11	+2	—7
West South Central	—1	—7	—8
Mountain	—13	—12	—16
Pacific	—4	—4	—6

▼

Canadian Group Shows Increase in Output

Electric output of companies comprising the Power Corporation of Canada group showed an increase of 71,042,374 kw.-hr. for 1931 over 1930. This amount represented an increase of 4.2 per cent and was largely accounted for by the inclusion for seven months of the year of the output from the Seven Sisters plant of the Northwestern Power Company.

Apart from that company's output of 50,235,200 kw.-hr., the total increase noted for the year was 20,807,174 kw.-hr., equal to more than 1 per cent, which is significant in view of the general business conditions during the year.

The largest increase reported by individual companies was the total of 418,226,810 kw.-hr. by the Canada Northern Power Corporation, which represents an increase of 14 per cent over its total output for 1930.

Domestic Sales Still Growing

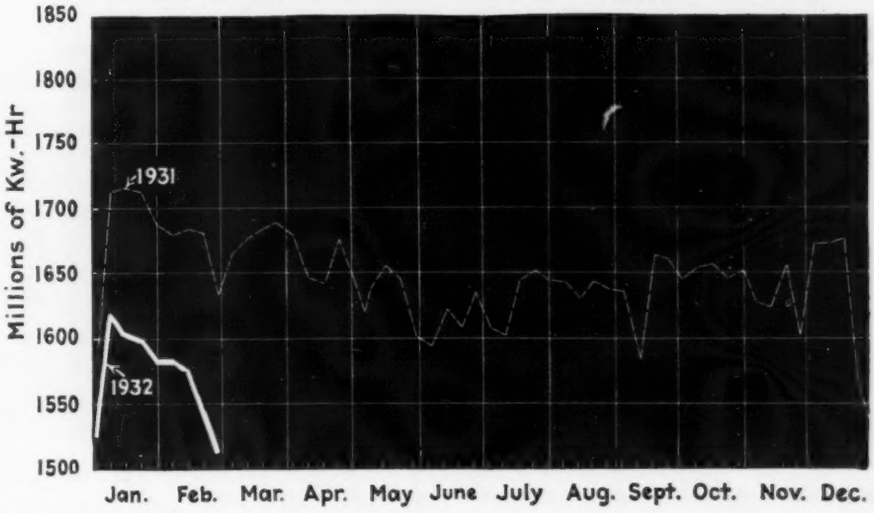
Analyzing reports of operations of electric light and power companies in December, the National Electric Light Association announces the following allocation of energy used by ultimate consumers, estimated for 100 per cent of the industry:

	Millions of Kw.-Hr. 1931	1930	Per Cent Change
Total energy for distribution	7,256	7,567	—4.1
Lost in transmission, etc	1,364	1,359	—0.3
Sold to ultimate consumers	5,892	6,198	—4.9
Domestic service	1,161	1,129	+2.8
Commercial, retail	1,204	1,282	—6.0
Commercial, wholesale	2,793	2,972	—6.0
Municipal street lighting	232	224	+3.5
Railroads, street and interurban	406	488	—16.8
Railroads, electrified	49	58	—14.7
Municipal and misc	47	45	+5.4

Energy for domestic use continues its relative increase over the preceding year, though the percentage gain is much smaller than it was earlier in 1931, the average increase in this item for the entire year being given as 7.0 per cent. The growth of sales for municipal use will also be noted. Energy for company-owned railways, 88,172,000 kw.-hr. in December of 1931 and 110,739,000 kw.-hr. in 1930, is not included in the sales to ultimate consumers.

▼

Holiday Cuts Week's Output



OUTPUT of electric light and power plants was 7.4 per cent less in the week ended February 27 than in the corresponding week of 1931, it is reported by the National Electric Light Association on the basis of its weekly telegraphic survey. The total is smaller than in the preceding week because of the national holiday, but the decrease was no greater than last year, when Washington's Birthday fell on a Sunday and so would presumably have a smaller influence on the week's energy consumption.

Operations on the Atlantic seaboard picked up slightly, compared with 1931, declined on the Pacific coast and continued low in the central area.

Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
February 27	1,512	1,633	1,744	1,707
February 20	1,545	1,680	1,746	1,699
February 13	1,579	1,684	1,770	1,718
February 6	1,589	1,679	1,782	1,726
January 30	1,589	1,687	1,809	1,728

Per Cent Change from 1931

Region	Week Ended Feb. 27	Feb. 20	Feb. 13
Atlantic seaboard	— 2.6	— 4.8	— 3.6
New England alone	— 2.5	— 4.6	— 4.2
Central industrial	—11.7	—12.2	— 9.7
Chicago district	— 8.3	— 7.5	— 8.5
Pacific coast	— 9.2	— 5.1	— 2.4

Frame Welding Creates New Industry

A new development which supplants older methods and which creates what virtually amounts to a new industry, one nucleus of which will be located in Cleveland, is seen in the announcement of the newly established welding division of the Austin Company. This division, located at East 222d Street and Nickel Plate Railway, is equipped to make weldings in the form of frames, bases and parts used in the manufacture of various kinds of production machinery, construction equipment, road machinery, lathes, presses, special machinery, booms, factory furniture such as benches, racks, etc., and frames for many products, some of which are now in the form of casting. All this work is for fabrication of parts for new or original equipment and machinery only.

At the Bliss mill, operated by the Austin Company, where structural steel is both riveted and welded, more than 3,000 tons of structural steel were welded during 1931 for approximately $3,000,000 worth of building construction. The success of this work largely induced the establishment of this newer and allied line for welding purposes.

It is claimed that these weldings, as the new products are called, offer a number of advantages and savings. The major saving claimed is the elimination of patterns, pattern storage, shipping and handling, which result in lower manufacturing cost. Weldings, it is claimed, also offer a decided advantage for jobbing work where only a few units are to be made. The lower weight of welding is another advantage claimed.

Austin's testing facilities at the Bliss mill will be available to assist manufacturers in developing their products to permit the use of welding.

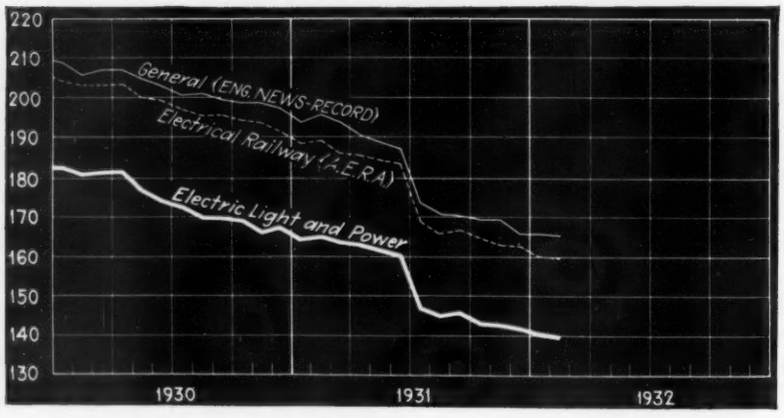
▼

Emerson Electric Surplus Reduced

Audited statement of the Emerson Electric Manufacturing Company for the year ended December 31, 1931, shows profit and loss surplus reduced to $393,266 from $631,028 at the close of the previous year. Current assets amount to $1,896,000, against current liabilities of $104,598. Cash stands at $191,538; short-term government securities, $201,593; short-term bonds, $199,578, and trade acceptances, $122,421, totaling $715,000, against $438,000 a year ago. Inventories have been pared down to $940,000 from $1,336,000 and receivables have been reduced to $240,800 from $386,900 a year ago.

▼

Construction Costs Continue Decline



Electric light and power construction costs took another downward step in February, according to computations by Prof. Albert S. Richey. The index now stands only 40 per cent higher than in 1913. This is not only the lowest point in the past five years, as the table shows; it is the lowest since the latter part of 1916.

Comparative values of three construction indices are here shown: Electric light and power, electric railway and the general construction index of the *Engineering News-Record*. They all show similar changes. Monthly index numbers for the first named, beginning with 1914, were published in the ELECTRICAL WORLD for February 13, page 318.

Construction Cost Indices: Electric Light and Power, Electric Railway and General

Base 1913 = 100

	Electric Light and Power*	Electric Railway*	General—*Engineering News-Record*
February, 1932	140	160	161.8
January, 1932	141	161	162.5
December, 1931	142	163	166.2
February, 1931	165	189	196.6
Last five years' high	184	206	210.4
Month	April, 1929	Nov., 1928	Feb., 1929
Last five years' low	140	160	161.8
Month	Feb., 1932	Feb., 1932	Feb., 1932

*Computed by Albert S. Richey.

▼

91,663,000,000 Kw.-Hr. in 1931

Revised data on output of public utility plants announced by the U. S. Geological Survey indicate a total for 1931 of 91,663,000,000 kw.-hr. This differs slightly from the figure published some weeks ago, because of revisions in the last two months.

The statistics in the accompanying table, it should be observed are not for electric light and power along but for all public utilities, including plants for electric traction and others contributing to the public supply of eectrical energy.

Monthly Output of Public Utility Plants

	Millions of Kw.-Hr.		Per Cent Change		Produced by Water Power (Per Cent)	
	1931	1930	1930 to 1931	1929 to 1930	1931	1930
Jan.	7.947	8.663	—8	+5	30	34
Feb.	7.160	7.627	—6	+3	30	36
March	7.876	8.187	—4	+2	34	40
April	7.643	8.019	—5	+2	41	41
May	7.639	8.064	—5	0	41	40
June	7.526	7.784	—3	0	38	39
July	7.766	7.899	—2	—2	35	37
August	7.628	7.906	—4	—5	32	32
Sept.	7.532	7.792	—3	—3	29	29
October	7.765	8.195	—6	—6	27	28
Nov.	7.406	7.693	—4	—7	28	29
Dec.	7.775	8.108	—4	—5	35	29
Year	91.663	95.936	—4.5	—1.5	33	34

▼

Driver-Harris Net Loss $202,000

For the year ended December 31, 1931, the Driver-Harris Company reports net loss, after taxes, interest, depreciation and other charges, totaling $202,778, against net profit of $259,568, equivalent, after preferred dividends, to $2.07 a share on 89,170 shares in 1930.

▼

Copper Falls in New York Market

Copper prices made new all-time lows this week, and lead sold at a new low for the current depression. Sentiment in all non-ferrous metal circles also made a new low, if that were possible, owing chiefly to the almost constant threat of a break-up in the international copper agreement.

	Feb. 24, 1932 Cents per Pound	March 2, 1932 Cents per Pound
Copper, electrolytic	6.25	5.75
Lead, Am. S. & R. price	3.75	3.25
Antimony	6¾	6¾
Nickel, ingot	35.00	35.00
Zinc, spots	3.175	3.10-3.15
Tin, Straits	22.20	22.25
Aluminum, 99 per cent.	23.30	23.30

New Corporation Launched by Phelps Dodge Group

Reflecting the prevailing trend toward increased specialization in industry comes the announcement this week of a completely new alignment of the fabricating subsidiaries of the Phelps Dodge Corporation. A new unit in the form of a vertical combination, the Phelps Dodge Copper Products Corporation, is launched as the backbone of the now complete "mine-to-market" organization.

The name of the present fabricating subsidiary, National Electric Products Corporation, will hereafter be the corporate title of the National Metal Molding Division of the Company only. National Electric Products Corporation will have its headquarters at Pittsburgh and be under the direction of W. C. Robinson, president. Its plant is at Ambridge, Pa., and among the many products of national distribution which it manufactures are rigid and flexible steel conduits, metal molding, armored cable, non-metallic conduit, thin-walled tubing and oval-duct, steel outlet boxes and switch boxes, rubber-covered wires and steel-protected cables.

The newly organized unit, the Phelps Dodge Copper Products Corporation, which will be headed by Wylie Brown, as president, will take over and operate the other fabricating divisions of the company's business. These include the American Copper Products Division with mills at Bayway, N. J., manufacturer of copper rods, wire and strip, busbars and special shapes, stranded cables, trolley wire, bronze and brass wire and weatherproof wire; the British American Tube Division with mills at Bayway, N. J., manufacturer of brass, bronze and copper pipe and condenser tubes; the Inca Manufacturing Division at Fort Wayne, Ind., manufacturer of enameled copper wire, coils, magnet wire, and the P-M-G Metal Division, manufacturer of copper and copper alloys in fabricated shapes which have special corrosion-resisting qualities.

The Habirshaw Cable & Wire Corporation, of which Wylie Brown is also president, will operate as a subsidiary of Phelps Dodge Copper Products Corporation. Habirshaw has plants at Yonkers and Nepperhan, N. Y., and Bridgeport, Conn., and manufactures a complete line of rubber- and lead-covered copper wires, paper-insulated power cables, telephone and telegraph wires, signal wires, parkway cables and miscellaneous cables of all kinds.

Both the Phelps Dodge Copper Products Corporation and Habirshaw Cable & Wire Corporation will move their present offices on March 21 to 40 Wall Street, adjacent to the offices of Phelps Dodge Corporation. National Electric Products Corporation, in addition to its Pittsburgh offices, will have a sales office in New York City.

Through acquisition of the Calumet & Arizona Mining Company and prior acquisition of the Nichols Copper Company and the National Electric Products Corporation, Phelps Dodge Corporation is one of the three large units in the copper industry in the United States. Its operations extend from mine to market and a large part of its copper production is sold in fabricated forms.

▼

Smaller January Revenue Than in 1931

Earnings of electric light and power companies are not making a particularly good start in 1932, according to returns for the first month of the year thus far received by the ELECTRICAL WORLD in its monthly survey. These show revenue 3.9 per cent smaller than in January, 1931, and indicate an estimated total of $189,200,000 for the entire industry, against $196,970,000 a year ago and $185,050,000 in December.

January is always the peak month of the winter for revenue; the present figure, if substantiated by reports still to be received, makes the rise from December smaller than in other recent years. Though smaller than in 1930 and 1931 the new January figure is larger than in 1929 or any earlier year.

Reporting companies in the South Atlantic States had a slightly larger revenue than that of a year ago; those in other regions had a decrease ranging from about 1 per cent in New England to 6 per cent in the industrial Middle West. In general the regional changes show little alteration from the conditions indicated for December in the tabulation published last week.

Major New Construction This Week

THE Chicago Union Station Company has secured a permit for a multi-story power plant to cost $295,000 with electrical and steam equipment.

Motors, controls and miscellaneous electrical equipment to cost about $75,000 will be installed in Harvard School for Boys, Westwood, Calif., total cost over $900,000. Plans authorized.

Heavy-duty motors, industrial lighting and other electrical equipment for machine drives, etc., to be installed in $150,000 addition of Merck & Company, Rahway, N. J., manufacturer of chemicals.

Power transmission line planned by Midwest Refining Company, Chicago, from electric power plant in Salt Creek oilfields to Casper, Wyo. Cost over $75,000.

Bids open until April 6 by Bureau of Yards and Docks, Navy Department, Washington, D. C., for complete electrical apparatus for operation, traveling bridge crane and other equipment for naval air station at Sunnyvale, Calif.

Electric machine drives, controls, motor-driven conveyors, industrial lighting equipment, etc., needed in $125,000 plant to be built by White Cap Company, Chicago, Ill., manufacturer of metal caps for food containers.

Bids will be asked soon by Orleans Levee Board, New Orleans, La., for floodlighting equipment and beacons for a $375,000 airport. Plans have been approved.

Series of electric-operated pumping and booster stations, with motors, pumps, controls, etc., to cost over $45,000 planned by Old Dutch Refining Company, Muskegon, Mich., for proposed 100-mile oil pipe line.

▼

Delinquent Electrical Accounts

(National Electrical Credit Association)

Number of Accounts Reported

Division	January 1930	January 1932	Per Cent Inc. or Dec.	Twelve Months 1930–31	Twelve Months 1931–32	Per Cent Inc. or Dec.
New York	248	220	—11.3	3,258	2,809	—13.8
Middle and Southern Atlantic	129	127	— 1.6	1,689	1,390	—17.7
New England	82	103	+25.6	1,351	1,140	—15.6
Central	630	488	—22.5	8,054	6,481	—19.5
Total	1,089	938	—13.9	14,352	11,820	—17.6

Total Amounts Reported

	January 1930	January 1932	Per Cent Inc. or Dec.	Twelve Months 1930–31	Twelve Months 1931–32	Per Cent Inc. or Dec.
New York	$33,480	$20,392	—39.0	$468,121	$339,671	—27.4
Middle and Southern Atlantic	14,541	14,194	— 2.4	270,900	173,378	—36.0
New England	5,241	6,506	—24.1	156,994	93,763	—40.3
Central	58,988	41,727	—29.3	975,557	574,227	—41.1
Total	$112,250	$82,819	—26.2	$1,871,572	$1,181,039	—36.9

▼

Five-Million-Dollar Offering by Duquesne Light

First mortgage 4½ per cent gold bonds of the Duquesne Light Company have been issued to the amount of $5,000,000, the price being 92 and accrued interest, to yield 5.06 per cent. These bonds, dated March 1, 1932, will mature March 1, 1957. This is the first electric light and power issue to appear in March. Virginia Electric & Power Company is expected to enter the market in the near future.

Lockport, N. Y., Sues Power Board

Members of the Federal Power Commission received notice on Monday of a suit by the city of Lockport, N. Y., in the District of Columbia Supreme Court enjoining the commission from allocating 275 sec.-ft. of water from Eighteen-Mile Creek to the Niagara Falls Power Company (ELECTRICAL WORLD, February 6, page 253). The commission thereupon adjourned a hearing in the matter scheduled for that day.

▼

Hood River (Ore.) District Sought

Desire for a "people's utility district" in the Hood River district of Oregon is the motive of petitions for a survey just filed with the Oregon State Hydro-Electric Commission. The estimated cost of the development is placed at $850,000, $590,000 for plant construction and $260,000 for transmission and distribution. Horsepower to be developed amounts to 2,500, and the source of water-power supply is the West Fork of Hood River.

▼

Appliances, Safety, St. Paul Topics

Electricity now costs customers on the average 30 per cent below the 1913 figures, H. S. Bennion, N.E.L.A. director of engineering, told the Engineering Section of the North Central Electric Association at its meeting in St. Paul last week. As consumption increases this price will be reduced still more, he said, and as prices are gradually reduced more people will buy electrical devices. Lack of a sense of accuracy, "square pegs in round holes" and lack of interest in the work were cited as causes of accidents in a round-table discussion led by Everett Baxter of Omaha, Neb. An employees' safety organization in every plant was advocated by D. L. Oalund of Huron, S. D.

▼

Hamlet Orders Wires Buried

Through an injunction, the Georgia Power Company is seeking to prevent the town of Homerville, a place of 630 inhabitants, near Valdosta, from enforcing an ordinance which would require all electric wires carrying 110 volts or more to be placed underground. The power company contends that the ordinance is drastic and unreasonable.

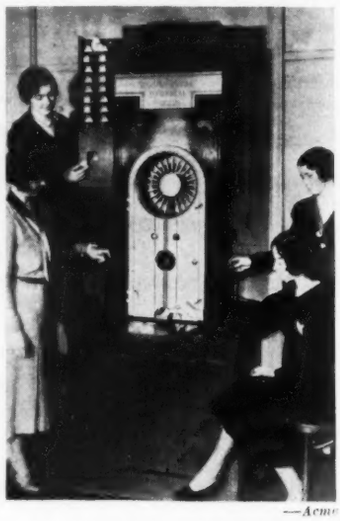
▼

Illinois Public Service in Quincy

The Quincy (Ill.) City Council on February 23 voted unanimously to accept a proposal of the Illinois Public Service Company to move its headquarters from Springfield to Quincy in return for a 40-year franchise for light and power and gas in the latter city. The franchise is non-exclusive, allowing other companies to enter the Quincy field. It also provides that the company must furnish without cost to the city a new downtown lighting system. The company will maintain its personnel in the new Springfield office building.

▼

VERTICAL PARKING MADE QUICK AND EASY



—Acme

Chicago now has a 48-car parking garage 105 ft. high right in the "Loop." The young women are demonstrating the Westinghouse 75-hp. control unit, with a miniature model of the storage machine on the left. Cars can be delivered automatically in from 10 to 55 seconds.

▼

Fort Collins Against a City Plant

Fort Collins (Colo.) authorities have been discouraged by engineering advice from taking steps to erect a municipal power plant, which would require a bond issue of between $745,000 and $907,000. Instead, it will ask a reduction of rates from the Public Service Company of Colorado.

▼

Hat Creek Plant Again in Use

Hat Creek power house No. 2 on the Pacific Gas & Electric Company's system in northern California is back in operation again after a year of inactivity as the result of an injunction granted L. P. Joerger, Shasta County rancher, who claimed riparian rights to the water used in the operation of the plant (ELECTRICAL WORLD, October 17, 1931, page 678), the California Supreme Court having ruled that an appeal from the injunction stayed its effect.

South Carolina Drought Past

Lake Murray, which is formed by the large earth dam of the Lexington Water Power Company, 14 miles from Columbia, S. C., now has more water in it than ever before, lacking only 11.1 ft. of being up to the spillway gates. Although the big lake has been coming up gradually for several weeks, the fullness was helped by recent heavy rains. The water measured on February 28 about 225 ft. from the tailrace of the river bed at the intake towers. At present two of the four 55,650-hp. generators are being operated.

▼

New Wyoming Line Planned

Bids are being solicited by the Midwest Refining Company—a Standard Oil concern—for an electrical transmission line from its Salt Creek electrical plant to Casper, Wyo. The plan is to produce electric power in the Salt Creek oil field and use this power in the Midwest's refinery at Casper.

▼

Maryland Commission Assailed

Charging that the Maryland Public Service Commission had permitted the United Railways of Baltimore to inflate its valuation figures to include "some $20,500,000 of practically 'pure water' common stock," and had also accepted a rate base for the Consolidated Gas, Electric Light & Power Company nearly equal to the par values of all its outstanding securities, the Park Heights Civic Improvement Association has petitioned Governor Ritchie to remove the present commissioners and appoint others.

▼

Texas Farms Need Appliances

Electric power transmission lines in Texas have caused a vast increase in the demand for electric appliances on the farms of the state, according to P. M. Monford, Texas Agricultural and Mechanical College, director of research in electricity as applied to agriculture. In a recent address at San Antonio Mr. Monford pointed out that a market for 1932 of about $1,000,000 worth of electrical appliances exists in Texas on the 10,000 farms supplied by high-tension lines from central stations, not to mention 13,000 farms supplied by small individual farm plants.

▼

Montana Case in Supreme Court

A hard-fought case involving a contention between the Montana Public Service Commission and the Great Northern Utilities Company was argued before the United States Supreme Court

last week. It arises from the refusal of the commission to allow the utility to sell gas at Shelby at a lower rate than that fixed by the regulatory body, in order to undersell another gas company which charges the same rate as that fixed by the commission. The Great Northern claimed that the reduction was necessary to its self-preservation, but the commission maintained that it fixed a specific not a maximum rate, and the Montana Supreme Court held that a statute permitting the commission to do this was constitutional. A federal court granted a temporary injunction to the Great Northern. This injunction was upheld by the United States Supreme Court without prejudice to a further hearing by the District Court in Montana.

▼

Mercury Switches Used in Tap Changing Abroad

So successful has the experimental use of mercury switches in tap-changing transformers proved to be abroad that new designs are incorporating this feature as a standard. The switches used are inert-gas-filled mercury units, with a porcelain lining to keep the arc away from the glass, and the length of the connection between the electrode and the tube is almost equal to the tube diameter, the electrode being taken through the upper wall of the tube and the glass being drawn down on it. Exhaustive tests are said to have shown that these heavy-duty switches are entirely suitable for such service. These included life tests on single switches up to 2,000,000 breaks at full-load current and full voltage, short-circuit tests in the closed position and flash-over voltage tests in the open position.

The characteristic quick-make-and-break action of these switches is especially valuable in the event of the gear stopping in an intermediate position since the partial contact which may be encountered with other switches cannot occur. No maintenance work is necessary, and as these inclosed switches as used by Ferranti, Ltd., can be oil-immersed in the main transformer bank, no tapping connections have to be brought out of the tank.

▼

Surge Tests Given to Energized Transformers

Another step forward toward the defeat of the lightning demon was made at the Sharon (Pa.) works of the Westinghouse Electric & Manufacturing Company last week when for the first time the feasibility of commercial surge tests on high-voltage power transformers under exact service conditions was demonstrated. In these tests million-volt surges were thrown on a 115-kv., 7,500-kva, three-phase core-type transformer while excited with 60-cycle power at rated voltage. Any failure of the transformer's insulation to withstand the surge voltage is at once evident by the flow of power current, just as occurs in lightning troubles.

Such testing of transformers is timely in view of the evident dissatisfaction with present dielectric testing methods expressed by engineers attending the winter A.I.E.E. convention recently. The new method may give fresh impetus toward testing standardization, a problem of pressing importance since the discovery that increasing barrier insulation creepage distances in a transformer merely raises the 60-cycle flashover voltage without necessarily increasing the impulse strength.

The new method, which has been suggested as an ideal test, has hitherto been impracticable because the power "follow" current endangers the surge apparatus. Westinghouse engineers solved the problem by an ingenious use of the principle of the Torok tube. To insure that power current will follow in every case of failure of the transformer insulation to withstand the surge voltage, the surge is timed to occur precisely as the power-voltage wave reaches its crest.

In the combination surge and power test the 60-cycle arc over the bushing is proof that the transformer insulation withstood the surge voltage. With this test the power current follows any insulation failure produced by a surge which is likely to cause trouble in service. On this test the bushing was deliberately flashed over to give a visual conception of what would have occurred inside the tank had the windings failed.

Neutron Moves from Hypothesis to Identification

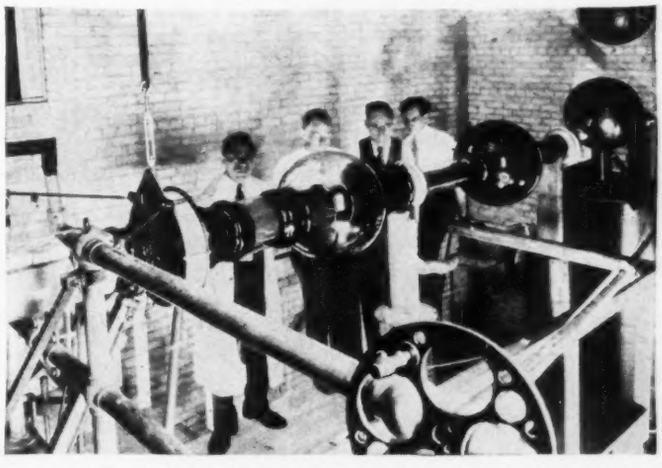
Reports from Cambridge University indicate that Dr. James Chadwick has identified the neutron, which heretofore has been in the realm of hypothesis except in so far as the five-year-old photon is a special form of neutron. As interpreted by Prof. Arthur H. Compton, it is presumably a combination of one or more electrons and protons into a compact nucleus manifesting no electrical charge. It thus has an atomic number of zero as contrasted with hydrogen and helium having atomic numbers of one or two respectively. Its discovery, if confirmed, will give much impetus to the advance of subatomic research aimed at revealing the mechanics of forming atoms.

Dr. R. A. Millikan pointed out that Chadwick's research has been an extension of the work of Bothe in producing very penetrating radiations by bombarding the beryllium atom with particles of polonium. These Bothe interpreted as artificial gamma rays. The difficulty rests in differentiating neutrons from photons (high-energy light waves), because neither are deflected in a magnetic field.

Scientists generally have hailed the Chadwick discovery as the most significant move in atomics since Rutherford in 1911 demonstrated the nuclear structure of the atom. Lord Rutherford himself has attached great importance to the new disclosure. It is said that it takes 200 septillion (2×10^{23}) neutrons to make an ounce of mass. The neutron therefore takes its place halfway between the helium atom and the ultimate electrical unit of matter.

▼

NEW YORK HOSPITAL HAS 900-KV. X-RAY TUBE



In the great X-ray tube of the Memorial Hospital, New York City, developed by Dr. W. D. Coolidge of the General Electric research laboratory at Schenectady, the electrons are twice accelerated before they strike the target, producing X-rays of tremendous penetrative power

EDITORIALS

L.W.W.MORROW
Editor

Will taxes nullify the good of credit measures?

WHEN the grocer attempts to balance the beam of his scales he puts a bit more sugar on one side or takes off a weight on the other. The government is trying in a dozen ways to sugar credit in the effort to restore business equilibrium, but it is adding more weight than it has sugar when it loads any tax, especially a sales tax, on the already sagging side of the scales. Credit elastification is proceeding on the assumption that business will have the courage to borrow the fresh credits to expand operations and restock inventories—all in the hope that the habit will percolate to the ultimate consumer. Let us trust all that will eventuate.

But resumption of buying by consumers is not going to be aided by a direct tax on the staple essentials of day-to-day existence, one-time luxuries which have become the basis of our greatest industries. What logic is there in stifling the infectious spread of buying by making a simultaneous impost on commerce on the one hand and creating crucial unemployment by drastic cessation of governmental activities on the other hand as an accompaniment of the strong-arm budget balancing? True, there is a compelling wave of sentiment for slashing the foolishness out of governmental extravagance; direct taxes are advanced to teach that moral to the citizen. Better let that task ride for a brighter and saner day. Better now capitalize the good that credit limbering can do. Better, too, postpone the sales-tax experiment for a later era.

A sales tax on domestic electric consumption is a sales tax that will check the consumption of almost the only commodity service which people have patronized to an increasing extent, depression to the contrary notwithstanding. Will checking the expenditures for any of the essentials give consumers the buying confidence that is needed to justify the credit confidence on which everything is being staked? No, and therefore if the electrical industry acquiesces in the tax on the bills of domestic customers it does so supinely and by no means because it is persuaded that it will be economically efficacious in the emergency. Not because it is on electricity, but because it is a sales tax. If deficits must be met, let government fund some of them by borrowing in the same market where confidence is being restored by a promising concordance of measures.

Action on Muscle Shoals

FOR about fourteen years Congress has debated about the disposition of Muscle Shoals. Millions of words and many plans have resulted in nothing except possibly to dismay business and prevent it from trying to use Muscle Shoals as part of a business enterprise.

Now, however, Congress has from the Muscle Shoals Commission set up last year by the President and the two states most directly interested a report that should be acted upon. This nonpartisan and factual survey shows that it is preposterous from an economic point of view to use Muscle Shoals either as a nitrogen-fixation plant or a government light and power project. Yet these two ideas have formed the platform for virtually all of the past theories of operation. A complete development of the Tennessee Valley without cost to the government and the utilization of all the assets of Muscle Shoals is the proposal of the commission. Concentrated fertilizer can be made, power can be sold, flood conditions and

navigation improved, the raw materials of the Tennessee Valley can be used—all this as a private enterprise under conditions that safeguard the public interest.

Action is desirable now, and there is hope that the Muscle Shoals bill to be prepared under the auspices of the committee on military affairs will afford a reasonable guide for carrying out the recommendations of the Muscle Shoals Commission. If it does, it should be passed.

The cost of "saving" on street lighting

CURTAILMENT of municipal expenditures is the order of the day—and properly so, for it is incumbent upon municipalities to live within their incomes, as must individuals and businesses. Such curtailment may be carried out destructively or constructively. Done with unreasoning hysteria, it means disruption of basic municipal activities, with far-reaching ill effects. Done with calm analysis of all expenditures to determine those which offer the greatest value per dollar, it means the most effective use of the public funds.

Street lighting, it appears, is one of the first items of municipal expenditure to be attacked, even though the potential reduction in expense is slight and is accompanied by a disproportionately greater reduction in the illumination. Perhaps the principal reason for this action against street lighting is that municipal officials and the public at large have never fully realized its true value. People have been thinking of street lighting in terms of the comfort and convenience it affords—items which are real municipal assets, of course, but intangible—rather than in terms of the more tangible benefits of traffic facility and increased public safety.

Many law-enforcement officials have attested the value of good street lighting as a deterrent to crime—in fact, a crime reduction approximating 40 per cent is so attributed, according to a widely quoted survey. This function of street lighting is particularly important in municipalities where the police departments have been unable to obtain sufficent funds to provide adequate police coverage.

In another element of public safety—reduction in traffic accidents—good street lighting has proved to be a powerful factor. Recent analyses made by the National Safety Council and by others indicate that about one-third of the traffic accidents which occur at night are attributable to inadequate illumination compared with one-sixth a decade ago. This annual toll in our municipalities amounts to about seventeen hundred fatalities a year, with a correspondingly greater number of personal-injury and property-damage cases. The principal concern is, of course, the humanitarian one, but it is significant that the annual economic loss from these preventable accidents is almost as great as the total annual expenditure of all municipalities for street lighting. Street-lighting reductions mean inevitable increases in this traffic accident toll. The cost of "saving" on street lighting is jeopardy of public safety.

Organized research procedure

WHATEVER the source of a problem to be handled by a research organization, the first step in its solution is to formulate it as simply, exactly and concisely as possible. Outlining this procedure in a recent lecture, Dr. Frank B. Jewett, president Bell Telephone Laboratories, pointed out that the next step is to scrutinize the problem to determine not only the probability of a successful solution but also the probable time and cost of obtaining the solution and likewise the benefits anticipated from it. Breaking down the problem into its component uncertainties is the next stage. Each of these is then formulated in the most rigid possible set of requirements. Finally the components are assigned to the scrutiny and attack of those competent to handle them.

General supervision is exercised to insure (a) that progress toward an answer is at a reasonably uniform rate everywhere and (b) that the results obtained in one portion of the field do not prove to be of such a character as to alter the entire picture as it was originally conceived, necessitating a new attack from the new point of departure. Finally, when a satisfactory answer seems at hand, the composite solution is subjected to those over-all tests which are to determine its ultimate utility.

With respect to the Bell system Dr. Jewett declared that no piece of apparatus, equipment or method of operation is ever released for commercial use until it has been subjected to all the tests in the laboratory which the human ingenuity of the research and development organization can devise. Experimentation upon the customer and his service are as far as possible avoided.

It is certain that such methods of organized research are fundamentally responsible for the success attained on so large a scale in the development and application of new apparatus and methods in the communication field. There are many other branches of electrical engineering which can and do utilize to advantage these essential principles of research organization and guidance. Those which do not can profit by the example.

Kansas newspapers deprecate ban on merchandising

A FEW months only have passed since the Kansas law prohibiting utilities from selling appliances has been in actual operation. It is still a little early—there or in Oklahoma—for the full story of results to be written and the lessons to be drawn. But it was not too soon for the Kansas State Press Association at its recent convention in Wichita to pass a resolution condemning the statute. The publishers of the local newspapers of Kansas have made up their minds that it was all a mistake and have put their judgment on record. According to the editor of the Peabody *Gazette-Herald,* the Kansas papers are losing $300,000 a year in advertising revenue because the law was passed. This is bad for their business, and they believe that it is bad for local trade and for the public.

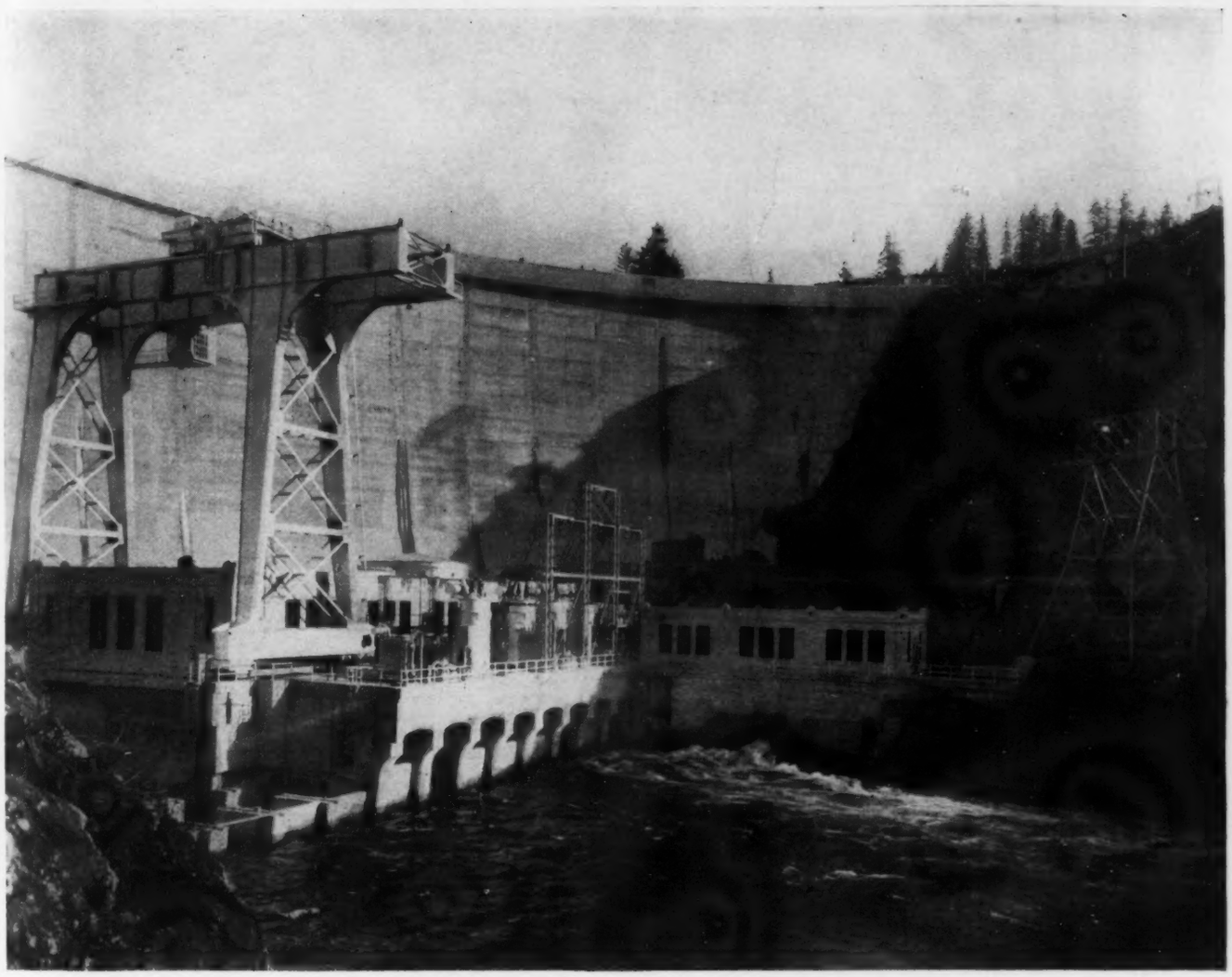
This is what inevitably will happen when the power company is no longer permitted to merchandise domestic appliances. Kansas is proving the case—that's all. Stores where public utilities formerly sold this household equipment at retail now stand vacant. Those who were employed in these merchandising activities are now idle. Householders can no longer have their appliances serviced free or at low cost, as they were accustomed to. Rural customers now have to go to the larger towns where they can find appliance stores or order from a mail-order catalog. Meanwhile the sale of appliances has fallen off, so that one town that sold 400 ranges in 1930 is now averaging one a month. Manufacturers and wholesalers find their business gone. The newspaper's appliance advertising has dropped to nothing.

The theory was that once the power company was out of the marketplace the business would all flow to the independent dealers. But it doesn't. The dealer has not increased his efforts to create demand and to draw trade to his store. So the business just stops flowing. For new electrical appliances are not staple necessities of daily need. Nobody seems to be benefiting by the law.

It is too late for the awakening of the Kansas newspapers to do much good—in Kansas. They should have thought of all this before and battled against the adoption of this law and saved this advertising revenue—in the public interest as well as their own. But the lesson of their belated conversion should not be lost on the newspapers of other states.

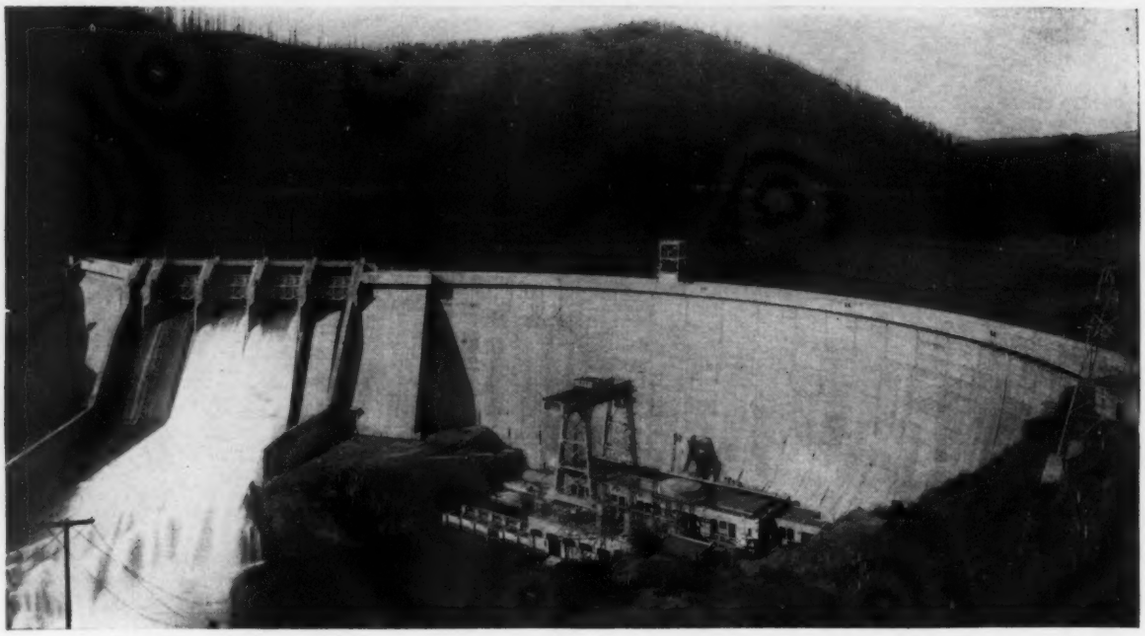
Valuable research by-products

BY-PRODUCTS of research are competing in value today with the results of inquiry along lines leading to definite objectives. As A. W. Page pointed out recently at the Lowell Institute in Boston, telephone research, which laid the foundations of the motion-picture industry, has prepared the way for television, advanced the method for aiding the deaf to hear, produced an artificial larynx, and contributed to the advancement of knowledge of electricity, metallurgy, pure mathematics and many other subjects. All of this has been incidental to the main purpose of improving electrical communication, particularly in voice transmission. Numerous other examples of the progress of man's welfare through research might be cited to emphasize the value of collateral advances resulting from devoted and sustained inquiry in scientific and engineering fields. Such instances strengthen the contention that funds allocated to investigation may often be expected to yield returns far beyond the expectations accompanying the launching and even the early stages of the inquiry.



Ariel—
newest station
in the Northwest states

At the base of this 313-ft. dam is the 45,000-kw. plant of the Inland Power & Light Company on the Lewis River, Washington. Notable features are full use of river width for station foundations, single arch dam, 728 ft. long at the top, water-cooling of concrete after pouring, largest overhung generator to date, control room in a separate building and most unusual provisions for protecting spawning salmon.



Ariel Hydro Development

By A. C. CLOGHER and W. S. MERRILL

Engineering Department,
Electric Bond & Share Company, New York

Largest overhung generator.
Largest outdoor power house crane.
Arch dam 313 ft. high.
Power house foundation arched across canyon.
Control room in separate building.
Fish trap built directly over draft tubes, catching fish for hatchery.

ARIEL, containing one 45,000-kw. hydro-electric unit, is the first plant in the vicinity of Portland, Ore., having reservoir capacity for seasonal storage and low-load-factor operation. The plant was built for the Inland Power & Light Company and is located on the Lewis River at Ariel, Wash., about 25 miles north of Portland. Heretofore, excepting in the case of some minor hydro-electric plants, the power supply for this territory has been secured from steam-electric and run-of-river hydro-electric plants.

Ariel will be used principally to augment the power supply of the Northwestern Electric Company in the territory served by that company in and around Portland, Ore., and in Vancouver and other parts of southwestern Washington. It is also interconnected with the Pacific Power & Light Company and The Washington Water Power Company (associated companies), which, in turn, serve extensive portions of the states of Washington and Oregon and a portion of western Idaho. With Ariel the present installed generating capacity of the above and affiliated companies has been increased to approximately 240,000 kw.

The full width of the river channel across which the dam is built is utilized for a generating station which will eventually comprise an installation of four 45,000-kw. units. This large ultimate capacity has been provided for because of the fact that additional power developments and storage reservoirs upstream on the Lewis River will eventually greatly increase the primary power available at Ariel. Also because of the fact that the storage available and the proximity of the plant to the cities of Portland and Vancouver make it desirable to provide for low-load-factor operation and emergency capacity, which can be installed in this plant relatively cheaply.

The existence of a deep gut in the volcanic rock, technically known as andesite, approximately 70 ft. wide and 120 ft. deep and filled with sand and gravel, presented a very difficult and interesting construction problem and called for unusual features in the design of the dam and power house.

The principal part of the dam, which is 313 ft. high, is a single arch having a top length of 728 ft. This arch crosses the main channel of the river and the gut referred to above. The power house is located immediately downstream from the arch dam and in order to provide a continuous foundation across the river for the four 45,000-kw. units a portion of the substructure is supported on a concrete arch under the draft tubes. For unwatering the bed of the river at the dam and power house site the water was by-passed through a tunnel equivalent in area to a 27-ft. diameter circle.

During a single low-water season of about four months the stream bed was unwatered, the sand and gravel excavated and the concrete arch dam constructed up to an elevation well above the ordinary low-water mark.

Construction work was started in November, 1929, and the tunnel was available for by-passing water in June, 1930. Practically all of the 307,000 cu.yd. of concrete in the dam was placed between April 1, 1930, and April 1, 1931.

The natural conformation of the site was not particularly suitable for an arch dam. The left bank presented a very favorable rock abutment up to the full height of the structure. On the right bank, however, favorable abutment conditions could only be secured by utilizing a section of gravity dam as the abutment for the upper 140 ft. of the arch. The topography was favorable for utilizing a portion of this gravity dam as a flood spillway. A concrete-lined channel carries the floodwater from the toe of the spillway to the river channel.

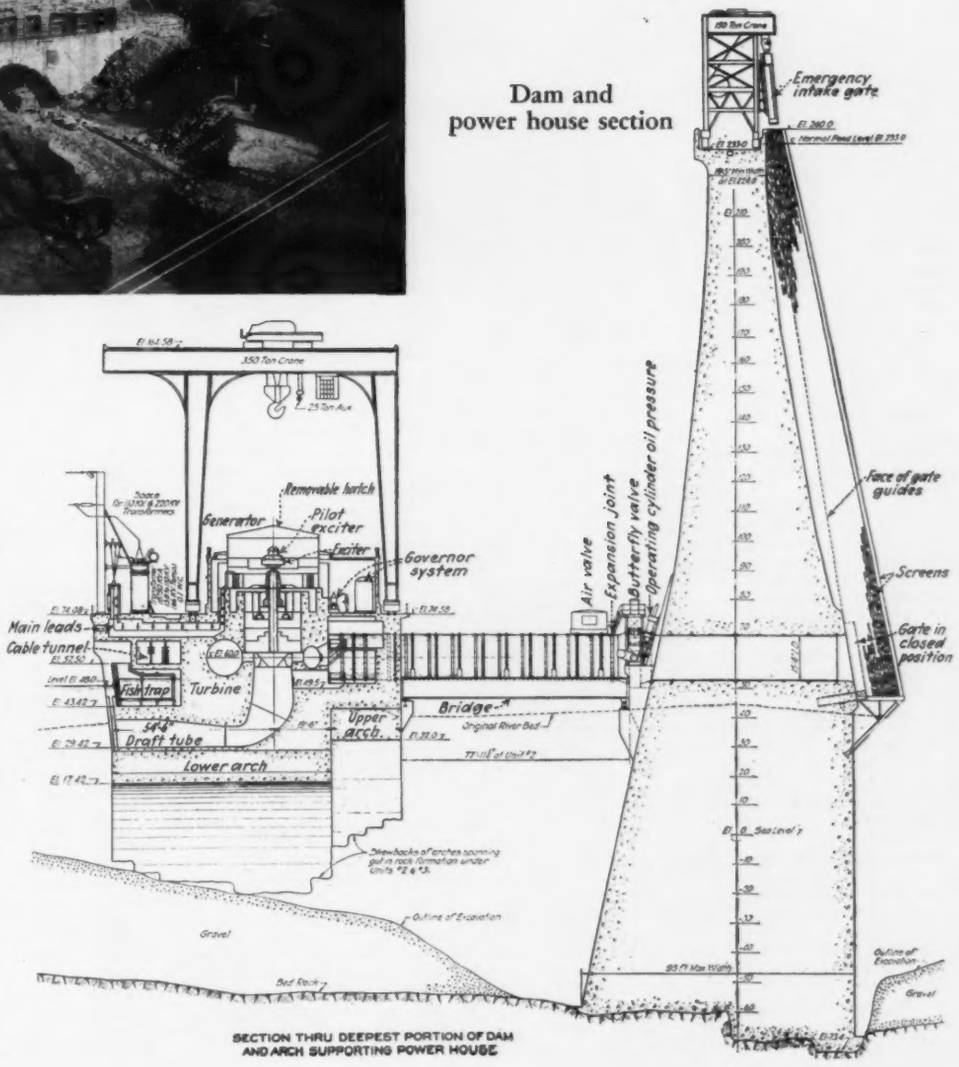
The single arch dam was designed by the trial-load method for a maximum stress of 600 lb. per square inch, and particular care was taken to reduce the temperature of the structure to approximately its future average annual temperature before grouting and before making the final closure. This problem was made unusually difficult on account of the comparatively high speed with which the dam had to be constructed. The gravity dam forming the right abutment was built first, so that there was approximately a year for it to cool. The transverse joints in this portion of the structure were grouted before final closure.

The arch dam was constructed in columnar sections approximately 30 ft. long with 2-ft. radial slots between sections. The slots were left open to assist in cooling the concrete during construction and the last concrete placed was utilized to fill these slots at a time when the columnar sections had reached practically their future average annual temperature. Consequently, the radial joints between the sections of the arch dam were not grouted.

Approximately 300 resistance type thermometers were installed at various places in the concrete and it was found by experiments in the earlier constructed sections

Concrete arch supports power house over deep river canyon

Dam and power house section



SECTION THRU DEEPEST PORTION OF DAM AND ARCH SUPPORTING POWER HOUSE

that a very appreciable increase in the rate of cooling could be accomplished by the insertion of pipes or by coring out the concrete so that water could be circulated through the holes in order to take away the heat. The last three sections of the arch dam to be constructed were left open for the purpose of passing the late winter and early spring floods of 1931. These sections were cooled in a relatively short time by coring out between 20 and 25 vertical holes in each section by means of 5-in. hollow rubber tubes. The columnar sections were

Hydraulic and Electrical Details of Ariel Development

Location—Twelve miles east of Woodland, Wash., on Lewis River 17 miles above junction with Columbia River and about 25 miles north of Portland, Ore.

Reservoir—Area at elevation 235 (reservoir full), 3,850 acres; usable storage capacity down to elevation 170 (drawdown 65 ft.), 220,000 acre-ft. Drainage area, 733 square miles.

Dam—Combination gravity and variable radius arch type, about 1,250 ft. long, of which 206 ft. is overflow spillway and 728 ft. arch. Maximum height of arch above river bed 313 ft. Arch designed by trial-load method, using maximum compressive stress in concrete of 600 lb. per square inch. Radius of upstream face of arches varies from 397 ft. at top to 247 ft. at bottom. Angle between ends of arches varies from 108 deg. at top to 80 deg. at normal tailwater (elevation 50); top thickness below overhang 19 ft. 5 in.; bottom thickness 93 ft. Total quantity of concrete in arch 198,000 cu.yd. Total quantity of concrete in dam, including arch, thrust block, spillway and non-overflow section, 307,000 cu.yd. One barrel of cement used per cubic yard. Nominal mix 1:2½:5. Spillway and non-overflow sections of dam provided with drainage tunnel and seepage wells drilled after grouting completed.

Spillway—Length, 206 ft., consisting of four 39-ft. and one 10-ft. openings, separated by 10-ft. piers. Five tainter gates 30 ft. high. Typical ogee profile for 30-ft. flood overflow. Discharge capacity 100,000 sec.-ft. with pond at elevation 235. Sloping concrete apron below overflow section with side walls 18 ft. 6 in. high. Five Willamette Iron & Steel Works sprocket wheel hoists, four of 85 tons and one of 60 tons capacity, all with link chains. The four larger gates are arranged for local control only, the 10-ft. one for local control and also for remote control by the station operator.

Intakes—Three-sided, structural steel structures on upstream face of arch at entrance to each penstock, consisting of straight horizontal and vertical members supported on rock or on brackets under penstock openings. Sides filled in with non-removable screen sections; upstream face filled with removable screen panels 15 ft. x 8 ft. 4 in. containing 2½x⅝-in. bars spaced 4 in. center to center. Compressed air to remove trash at face of screen and combat ice formation. Intakes for future units left low and removable screens omitted. Discharge into penstock can be shut off by gate described below.

Intake Gate—One fixed-roller type gate with roller bearings about 24x24 ft. to close a circular opening 17 ft. 6 in. diameter; gate supported normally on upstream face of arch on cantilever steel structure. Gate consists of girders and plates weighted with concrete. Total weight 105 tons; handled by 150-ton gantry crane on top of arch, which can place it over any of the four penstock openings. Gate closes by its own weight under maximum head on center of 175 ft.

Penstocks—Four 15-ft. 6-in. inside diameter, plate-steel penstocks ⅝ to 1 in. thick with butt joints and about 150 ft. long (75 ft. through arch), calked on inside; placed level. Penstock No. 1 has one horizontal bend between arch and turbine. This and future penstock No. 4 supported on concrete saddles. Future penstocks Nos. 2 and 3 to be supported on steel bridges between arch and power house. Penstock between power house and arch has 12-in. diameter Barrett air inlet valve and an expansion joint. Eighteen-inch diameter drain pipe in power house. Bell mouth at upstream end formed in concrete, enlarging from 15 ft. 6 in. to 17 ft. 6 in. diameter. One 3-ft. 9-in. inside diameter, ⅝-in. plate-steel exciter penstock through arch to power house. Also two 12-in. cast-iron pipes through arch for station service water supply.

Valves—One 17-ft. diameter butterfly valve with motor-operated bypass at downstream face of arch. Operated by oil pressure cylinder controlled by motor-driven pump. Designed for local and remote control, closing automatically with increase in velocity in penstock. One 36-in. butterfly valve back of house unit, hand operated. Valves furnished by the Pelton Water Wheel Company.

Turbines—One S. Morgan Smith Company vertical-shaft reaction wheel rated at 55,000 hp. at 170-ft. head and 120 r.p.m., guaranteed to develop 61,600 hp. at 185-ft. head maximum; plate-steel scroll case, inlet diameter 14 ft.; cast-steel Francis type runner, cast in one piece with hub for bolting to shaft; shaft forged steel in one piece, nominal diameter 34 in., length 28 ft. 6¼ in.; 6-in. automatic vacuum valve on head cover; one oil-lubricated steady bearing. Curved draft tube. Water required at 170-ft. head 2,800 sec.-ft. at maximum efficiency and 3,600 sec.-ft. at maximum gate. One S. Morgan Smith Company governor, oil-pressure, actuator type, designed to make full stroke in three seconds; flyballs motor driven from pilot exciter. Two Quimby gear pumps for governor system. One Leffel turbine for house unit, rated 1,050 hp. at 150-ft. head and 720-r.p.m., vertical-shaft, single-runner, semi-steel volute casing. Woodward governor.

Generators—One General Electric Company generator, umbrella type, with revolving field, rated at 56,250 kva. at 0.8 power factor, 13,800 volts, three phase, 60 cycles, 120 r.p.m., arranged for future use of damper windings and furnished with brakes, direct-connected exciter and pilot exciter; WR^2-55,000,000 ft.^{2}-lb. Pilot exciter provided with slip rings furnishing three-phase power at 155 volts and 8 cycles to drive governor flyballs. Ventilation by totally inclosed recirculating system with Griscom-Russell vertical coolers. House generator, General Electric Company 1,250 kva., 2,400 volt, three phase, 60 cycle, 720 r.p.m., with direct-connected exciter and pilot exciter. For main unit one Kingsbury combined guide and thrust bearing to support 550 tons rotating load in a common water-cooled oil bath supported on structural steel girders resting on sole plates. For house unit Kingsbury bearing also used.

Spare Exciter—One General Electric 300-kw., motor-driven exciter; motor 2,300 volts, three phase, 60 cycles; main and sub-exciters 250 volts d.c.

Auxiliary Power Supply—Two General Electric 1,250-kva., three-phase, 60-cycle, outdoor-type, self-cooled, 13,800/2400-volt transformers. One spare, one connected directly to main generator leads and supplying power to station auxiliary ring bus, from which feeders supply power to large auxiliary equipment, to village lighting system and to transformer banks to supply those auxiliaries requiring lower voltage. Three General Electric 200-kva., single-phase, 60-cycle, outdoor-type, self-cooled, 2,400/480-volt transformers to supply power to intake and tainter gates, cranes and other auxiliary motors above 10 hp. Three General Electric 50-kva., single-phase, 60-cycle, outdoor-type, self-cooled, 2,400/249-volt transformers supplying power to machine shop equipment and motors under 10 hp.

Main Transformers—Four 18,750-kva. (one spare) General Electric Company outdoor-type, single-phase, 60-cycle water-cooled, 13.2/115-kv., Y-connected; operated temporarily at 66 kv.

Control Room—Control room located in separate building downstream from transformer platform. General Electric bench-board type switchboard with vertical instrument and relay panels. Cable tunnel from station building terminates in basement under control room. Control cables laid in corrugated metal shelves in tunnel. Annunciators, Cory signal system and telephones effect communication between control room and generating floor.

Automatic Operator—I. P. Morris & De La Vergne, Inc., equipment of improved type arranged for automatically controlling either load or frequency.

Cranes—One gantry crane, 255 tons capacity when traveling (350 tons without impact, over center of unit); 25-ton auxiliary hook; 80-ft. maximum lift. One 150-ton crane on arch dam for handling intake gate. One 10-ton crane for handling fish. Cranes furnished by the Whiting Corporation.

Station Substructure—Power house substructure supported on rock at ends, but parts of units 2 and 3 supported on concrete arch spanning 67 ft. across deeply eroded gut in rock extending 103 ft. below the bottom of the draft tubes (73 ft. below sea level). Platform for supporting transformers and dead-end structures also supported from this arch. Space under platform utilized for main leads, conduit tunnel and fish traps.

Superstructure—Completed for first two units; 173 ft. long, 58 ft. 9 in. wide, 18½ ft. high, concrete walls; structural steel roof with 4-in. concrete slab covered with 1-in. insulation, tar and felt waterproofing, and finished with promenade tile. Control room superstructure similar but slightly lower. Practically all auxiliary operating equipment on power house main floor, removable hatchways over units and repair shop; double hung steel sash.

Fish Propagation—Fish trap located under transformer platform and conduit tunnel. Water supplied by 74.5 sec.-ft. pump, taking supply from tailrace. Fish caught in tank hoisted to truck at main floor level and hauled to hatchery two miles down river.

High-Voltage Switching—110-kv. line from transformers to switchyard, 800 ft. distant, where switching and synchronizing are done. Two Westinghouse outdoor-type, 115-kv., 600-amp., motor-operated oil circuit breakers, interrupting capacity 1,000,000 kva. Breakers equipped with condenser bushing potential device for synchronizing and for voltage and frequency indication.

System Connection—Initial installation of one 110-kv. line operating temporarily at 66 kv., connecting switchyard with Vancouver substation of Northwestern Electric Company. Power delivered to Portland temporarily by transmission line and overhead river crossing from Camas substation, this to be supplemented by a 110-kv. transmission line between Vancouver and Portland with submarine cable crossing under Columbia River.

built up at a rate of approximately 10 ft. vertically per day and just as soon as a section was completed the circulation of the water in the cored holes was commenced. River water was always available at temperatures not greater than 45 deg. F. It was found that this method did not greatly reduce the maximum temperature which the concrete would have attained without cooling, but it did very greatly accelerate the subsequent cooling, so that it was possible to make the closure of the dam several months before equal temperature conditions would otherwise have been secured.

Suitable sand and gravel aggregates were excavated from the river bed approximately 1,000 ft. downstream from the dam site. This material was washed and separated into sand and two sizes of aggregates and then put together in the proper proportions in the mixing plant. Specifications provided for the placement of all concrete in the dam by means of bottom dump buckets emptying directly over the location for the placement of the concrete. Almost all of the concrete in the dam was placed by means of Wiley whirleys, located on adjacent sections of the dam.

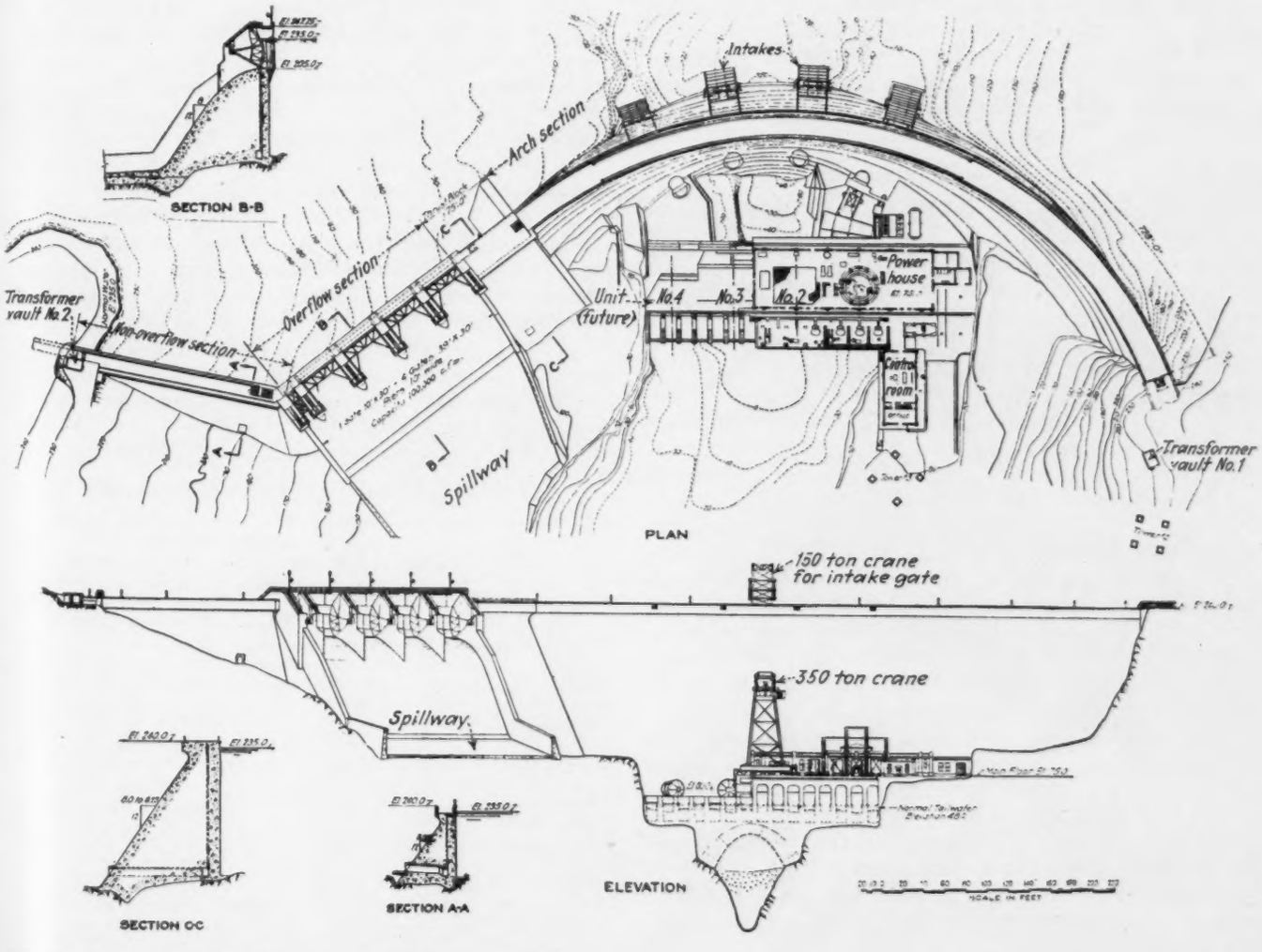
A notable feature of the construction plant was the almost universal use of trucks and caterpillars for all transportation excepting that of the concrete from the mixer plant to the dam. This transportation was accomplished by means of small gasoline locomotives operated on 3-ft. gage track. The site is approximately 12 miles from a railroad siding and all materials were hauled to the work on trucks, including 350,000 bbl. of cement, which was transported in bulk under contract in 10-ton trucks with especially designed bodies of 50 bbl. capacity.

A very simple penstock design was secured by passing four 15-ft. 6-in. diameter pipes through the arch on radial lines at the elevation of the scroll case. A small bell-shaped flare is provided at the upper end of each of these penstocks on the upstream face of the arch. A single penstock intake gate has been provided which is operated by a movable crane on the crest of the dam and may be utilized for an emergency cut-off on any one of the four penstocks. Each penstock will be provided with a butterfly valve immediately below the downstream face of the arch. The center line of the penstock is 175 ft. below the high-water surface of the reservoir.

Indoor-outdoor power house

The 45,000-kw. overhung, or umbrella type, generator with revolving field is the largest of this type which has yet been constructed. The small superstructure encloses the generator and the operating floor, the roof of the building being approximately flush with the top of the generator stator. The unit is provided with a direct-connected exciter located on top of the generator. This exciter is made accessible by a convenient stairway and

Plan, elevation and sections for Ariel hydro-electric development



passage built on the roof of the building. A 1,000-kw. alternating-current station service unit is provided for emergency purposes and for operation when the main unit is shut down, as it will be during the dry season on account of low daily load factor operation.

An outdoor gantry crane surmounts the superstructure and is utilized for handling all of the machinery in the power house as well as the transformers located on the downstream side of the station substructure. This gantry crane is the largest one of its type utilized for this purpose up to this time. It has a maximum capacity of 350 tons, a span of 67 ft. and a lift of 80 ft. above the crane rails. The transformers are removed from the operating position by lifting them vertically and then transferring them horizontally over the remaining operating transformers.

An unusual feature, especially for a hydro-electric station, is the placing of the control room in a separate building adjacent to the generating station building and approximately 35 ft. from it. This plan was adopted because it is expected that the future development of the power system in this territory will require the control of a large number of circuits connected to the switchyard as well as the control of four generating units. Consequently, a liberal space for the control room had to be provided, and it was found that the required space could be secured to better advantage in a separate building, making it possible to keep the size of the power house foundations down to a minimum and also to reduce the span of the large gantry crane used for handling the generating units and transformers.

The high-voltage switchyard is located on a bench about 800 ft. distant from the power house, where the switching and synchronizing are done. There is no low-tension bus or low-tension switching provided for on the main units themselves.

Fish-handling provisions

The Lewis River is a branch of the Columbia River and the construction of this project eliminated the Lewis River as a natural spawning ground for Columbia River salmon, so that there was presented a fish problem of very considerable commercial as well as recreational importance. In view of the fact that several additional power developments similar to Ariel are projected at upstream locations and also on account of the fact that there was grave doubt as to whether or not the salmon fry could go downstream past these structures, it was decided that no attempt should be made to move the fish from the tailrace into the reservoir above the dam. The commercial aspect of the fish problem was taken care of by co-operating with the Fisheries Department of the State of Washington and establishing a fish trap in the tailrace and a hatchery located about 2 miles below the plant. The fish trap is built under the transformer platform and from three different bays of the building water spills over weirs adjusted automatically to be always 18 in. above the elevation of the tailwater.

The water spilling over these weirs comes out of a flume built into the substructure of the power house. This flume is supplied with water from the river by means of a motor-driven pump which delivers 75 sec.-ft. under 4 ft. of head. At one end of this flume the fish, by following the current, jump into a tank, which can be removed by means of a special crane and loaded onto a truck for transportation to the hatchery.

This fish trap and hatchery have been in operation only during the fall of 1931, a season when only the smaller runs of salmon are coming up the river. The operation has worked out very successfully and the maximum rate at which the fish were observed to jump into the tank was about one every two seconds. Approximately eight million eggs were secured for hatching during the months September-December, 1931.

The plant was built for the Inland Power & Light Company by the Phoenix Utility Company and was designed by the engineering department of the Electric Bond & Share Company.

▼

20% Lower Annual Charges for Network System

CONFRONTED with a rapidly growing load in one of its districts and the fact that further load increases would require major expenditures for additions to substation, tie capacity with generating stations, and feeders to load, as well as distribution system changes, one company made a detailed comparison of the costs of supplying that district with two types of networks and the radial system then in use. To avoid complications it was assumed that the networks would be installed as if no system had previously existed and the cost of the radial system was based on existing conditions. The costs of the radial systems were not credited with the equipment which could be used or salvaged from the existing system. Results for three of the systems compared are presented in percentages because the company did not care to have actual costs published. However, it should be recognized that the figures are based on an actual layout and application of unit costs to each element of the system.

Without any credit for equipment which can be salvaged or retained from the radial system, it is interesting to observe that the radial system is 10 per cent more expensive than the secondary network fed direct from the generating station. But the network fed from substations is nearly 16 per cent more expensive, showing that the monetary benefits of a network cannot be obtained unless the intermediate substations are omitted. Analysis of the itemized figures indicates that the chief saving comes from the elimination of primary switching.

Table I—Distribution Systems Compared

Based on Given Area Supplied from the Same Generating Station

	Secondary Network		Radial System
	Supplied from Generating Station	Supplied Through Substation	Supplied Through Substation
Transformer connection (low voltage)	3 Phase — 4 Wire Y	3 Phase — 4 Wire Y	3 Phase Delta
System	Network	Network	Present tree system
Feeders			
Number	5	7	7
Size (thousand circ.mils or gage)	1 — 3 x 350	1 — 3 x 250 1 — 00	1 — 3 x 250 1 — 00
Transformers			
Number per bank	1	3	3
Rating of transformers (kva.)	1 — 500	3 x 150	2 — 200 1 — 75
Mains			
Number — size (thousand circ.mils)	3 — 1 x 500	3 — 1 x 500	2 — 1 x 800 1 — 1 x 200

Table II—Investment

(Expressed in Per Cent)

	Secondary Network — Supplied from Generating Station	Secondary Network — Supplied Through Substation	Radial System — Supplied Through Substation
Mains	9.0	9.0	8.2
Feeders	15.7	7.0	5.7
Manholes and subway	31.7	26.4	25.2
Vaults	4.2	3.1	3.1
Transformers	14.2	5.7	5.9
Network switches	Incl. in trans.	1.5	....
Primary switches	.....	0.3	0.5
Substation and transmission	.....	37.4	37.4
Meters	9.1	9.1	8.2
Services	16.1	16.1	16.1
Total	100.0	115.6	110.3

Table III—Energy Losses at Time of Annual Peak

(Expressed in Per Cent)

	Secondary Network — Supplied from Generating Station	Secondary Network — Supplied Through Substation	Radial System — Supplied Through Substation
Mains	17.6	17.6	15.7
Transformers	76.5	133.3	133.3
Primaries	5.9	43.1	43.1
Regulators	.....	37.3	37.3
Substation	.....	150.0	150.0
Transmission	.....	13.7	13.7
Total	100.0	395.0	393.1

Table IV—Total Annual Losses

(Expressed in Per Cent)

	Secondary Network — Supplied from Generating Station	Secondary Network — Supplied Through Substation	Radial System — Supplied Through Substation
Mains	8.2	8.2	7.6
Transformers	88.2	103.0	102.7
Feeders	3.6	19.8	19.8
Regulators	.....	28.8	28.8
Substation	.....	115.6	115.6
Transmission	.....	6.5	6.5
Total	100.0	281.9	281.0

Table V—Total Annual Cost of Losses

(Combined Energy and Demand Charges Expressed in Per Cent)

	Secondary Network — Supplied from Generating Station	Secondary Network — Supplied Through Substation	Radial System — Supplied Through Substation
Mains	13.2	13.2	11.9
Transformers	82.6	117.6	117.2
Feeders	4.2	28.5	28.5
Regulators	.....	29.9	29.9
Substation	.....	120.5	120.5
Transmission	.....	7.7	7.7
Total	100.0	317.4	315.7
Expressed in per cent of network supplied through substation	31.5	100.0	99.5

Table VI—Total Annual Charges

(Combined Loss and Investment Charges Expressed in Per Cent)

	Secondary Network — Supplied from Generating Station	Secondary Network — Supplied Through Substation	Radial System — Supplied Through Substation
Mains	9.6	9.6	8.8
Transformers and switches	18.1	16.2	15.4
Feeders	15.8	8.4	7.0
Manholes and ducts	31.5	26.3	25.0
Substation and transmission	.....	44.9	44.9
Meters	9.0	9.0	8.1
Services	16.0	16.0	16.0
Total	100.0	130.4	125.2
Expressed in per cent of network supplied through substation	76.7	100.0	96.0

substations and transmission thereto. This saving is partly offset by the increased expense for feeders and transformers, manhole and vault expense being only slightly larger.

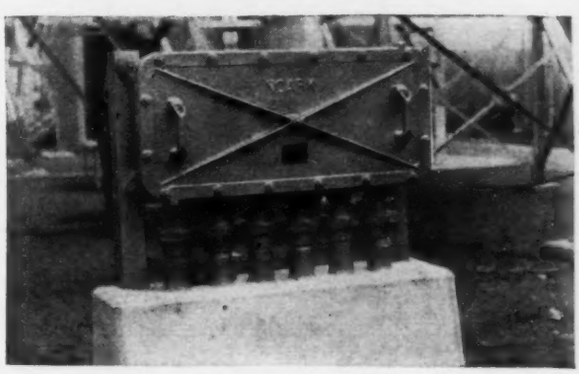
Another interesting situation is brought out in the analyses of energy losses. The radial system and the network fed from substations have losses at the peak period nearly four times that for a network system fed without an intermediate substation. This is due largely to the losses in the substations, regulators, transformer and primaries. Losses throughout the year are nearly three times as great on the radial and network system using intermediate substations compared with the direct-fed network. The demand charges on these losses make the total cost of the losses show up in bigger proportions.

Combining the value of these losses and the investment charges, the total annual charges of serving this particular district are 25 per cent greater for the radial system than the network fed direct and the network with an intermediate substation is still more costly, again indicating the impossibility of securing the maximum monetary benefits from a network if fed from distribution substations.

While these figures do not purport to show the increment costs of strengthening the system as load increases it should be obvious from the nature of a network that these increments are less for a network than a radial system. Provisions for increases in load on a radial system have to be made by increasing the substation capacity in fairly large blocks which may not be loaded up for some time as more and smaller additions to substation equipment would be too costly. If a substation is already loaded to capacity it would be expected that the next addition would increase the investment in the substation by the equivalent of another transformer bank.

▼

Control Circuit Terminal Boxes Serve Switchyard



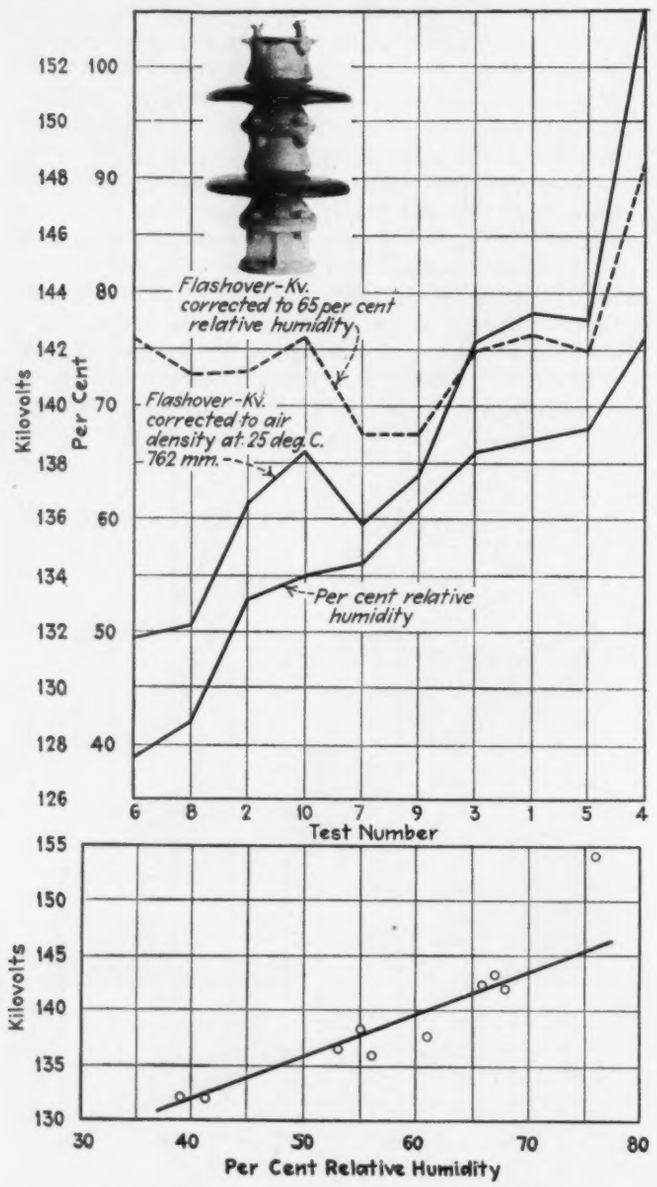
Sectionalization of 125-volt direct-current control circuits for solenoid-operated oil circuit breakers in the 115-kv. and 69-kv. switchyards of the Cabot station of the Turners Falls Power & Electric Company is conveniently accomplished by outdoor weatherproof terminal boxes mounted on structural steel columns set in concrete pedestals. Each box serves five breakers and is fed by a conduit line carrying the direct current necessary for solenoid operation. Besides expediting installation work, the arrangement facilities testing and trouble location.

Effect of Humidity on Insulator Flashover

By G. M. BARROW
Engineering Department,
Westinghouse Electric & Manufacturing Company, Derry, Pa.

Relatively large variations occur in the 60-cycle dry flashover value of a given insulator tested from day to day with the same testing arrangement.* An example is the report of an independent laboratory, giving the results of tests on 24 days on the same insulator, which shows a maximum value of 173 kv., minimum 146 kv. and an average of 159 kv., or an over-all variation of approximately 17 per cent. Some of the variation is caused by a corresponding change in air density, which is determined by the temperature and barometric pressure, but correction to unit air density for these variables does not give the uniformity in test values that is desired.

**A.S.A. specification C-29 gives standards for set-up and methods of testing.*


Kilovolts
Per Cent
Flashover-Kv. corrected to 65 per cent relative humidity
Flashover-Kv. corrected to air density at 25 deg. C. 762 mm.
Per cent relative humidity
Test Number
Kilovolts
Per Cent Relative Humidity

Variation of flashover with relative humidity
The insulator to which these data apply is shown.

Investigations within recent years have shown the important effect of humidity on insulator flashover. These are being continued in an effort to establish a standardized correction factor. It has been suggested that insulator flashover is influenced by the absolute humidity or actual moisture content of the air, rather than relative humidity, which is a measure of evaporation. If the breakdown of the air is entirely dependent upon the absolute humidity it would be expected that sphere-gap calibration would be affected by a variation in the moisture content of the air. The absence of such effect on sphere gaps suggests that on the insulator a surface stability exists which depends upon some combination of absolute and relative humidity. Some of the investigations show practically no fluctuation in flashover for given relative humidity values over a wide range of temperature and absolute humidity. This performance indicates that the rate of evaporation of moisture in the air, in contact with the insulator surface, is a more important factor than the total quantity of moisture.

Whatever reason future research may determine as the cause for such performance, laboratory tests show conclusively that the flashover value of current insulator designs increases and decreases with similar variations in humidity and reaches maximum at approximately 85 per cent relative humidity regardless of temperature over the normal atmospheric range.

The accompanying data, which were obtained on tests made under natural weather conditions over a period of several weeks on the two-unit insulator column shown, demonstrates the effect of humidity on flashover. From this data a correction factor is determined for reducing the flashovers to any selected value of humidity.

The correction factor is derived from the curve showing the flashover plotted against relative humidity. An equation $(y = kx + c)$ is established for the curve, which, from this data, gives $y = 0.39 + 116$. Taking two values of y: y_1 and y_2 at relative humidity x_1 and x_2

$$y_1 = 0.39x_1 + 116$$
$$y_2 = 0.39x_2 + 116$$

Dividing:
$$\frac{x_1}{x_2} = \frac{y_1 - 116}{y_2 - 116}$$

Solving for y:
$$y_1 = \frac{x_1}{x_2}(y_2 - 116) + 116$$

Let

y_1 = flashover kv. at 65 per cent relative humidity
y_2 = flashover kv$_2$ at any relative humidity $(\text{R.H.})_2$

$$\text{then kv.} = \frac{65}{(\text{R.H.})_2}(\text{kv}_2 - 116) + 116$$

By substituting the flashover and humidity values for the various tests in this equation all of the flashovers are corrected to 65 per cent relative humidity. The degree of uniformity in flashover values resulting from this correction is apparent from a comparison of the curves. The spread between maximum and minimum values is reduced from 22.2 kv. to 9.5 kv. and with the exception of one point the variation between the others approaches the limit of accuracy of the testing equipment.

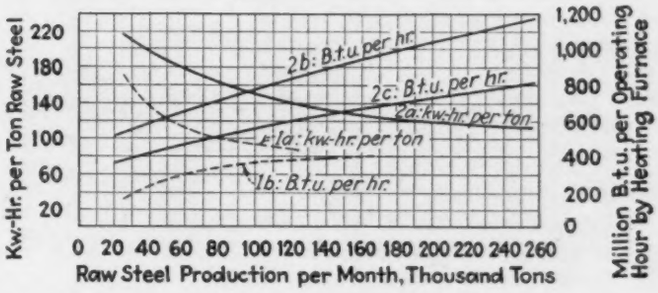
Steel Plants Have Regional Energy Potentialities

By A. H. DYCKERHOFF
Chicago, Ill.

DUE to the marked differences between steel plants in production, design and equipment, there are as great differences between them in their requirements for energy in the forms of fuel and electricity. These conditions are of great importance in the integration of steel mill energy structures with those of the electric and gas utility systems previously discussed.* The decisive factors in the entire energy balance of the steel plants are mainly the requirements for electrical energy by the rolling mills and fuel for the heating furnaces. The great variation of various steel plants is shown in the accompanying graph which gives upper and lower limits of such energy requirements. Curves 1*a* and 1*b* apply to a typical steel plant which has been selected as a prototype for integration with gas and electric utility systems. Curves 2*a* and 2*b* are based on the performances of several actual plants. The data on which curve 2*b* is erected includes operation of heating furnaces whose performances might be greatly improved by rebuilding as is indicated by curve 2*c*. Therefore, curves 1*a* and 2*a*, applying to electricity requirements, and 1*b* and 2*c*, covering fuel for the heating furnaces, can be taken as the reasonable limits of energy requirements through the range of steel plant design and output.

**See article "Regional Energy Co-ordination Embraces Steel, Gas, Power Industries," page 406, "Electrical World," February 27, 1932.*

The energy structure discussed in this article is that of a hypothetical, but none the less actual, steel plant. Hypothetical because the particular assembly of highly efficient operating units here treated does not exist; actual because the performance data on each unit are based on real operating records. The "ideal" plant thus assembled includes every means of energy economy that has been proved in practice — no untried schemes — and may be considered, from the standpoint of the steel plant as a self-contained energy producer and consumer, as the best that modern practice will allow. It may be said that any existing plant will fall far short of the paper and pencil performance of this hypothetical plant. The energy structure of even this "ideal" plant exhibits conspicuous wastes due to surpluses and deficits of energy.



Steel plant energy requirements are widely variant

This graph shows the requirements for electric power and heating furnace energy as functions of raw steel production of steel plants having different energy structures and different finished products.

For the purpose of this study "ideal" conditions have been assumed for the typical steel plant which is taken as of medium output. These ideal conditions imply high efficiency of stoves, of blowing equipment, of electric power plant and of heating and open-hearth furnaces and include such new methods as have been applied in various plants. This assumption is equivalent to conditions prevailing when building an entirely new steel plant of small or medium capacity and approximates circumstances applying to the extension of a large steel plant. Such a plant is shown in the diagram. The average heat requirement of the open-hearth furnaces is assumed to be 4,760,000 B.t.u. per ton of steel, using a mixture of blast-furnace and coke-oven gas, highly preheated in regenerators, thus making waste-heat boilers uneconomical. For the blowing equipment and electric power plant steam-turbine-driven units have been chosen, because such a selection represents best present-day practice for the reason that their performance and cost of generating electric power is equal, if not superior, to that of gas-engine-driven units. It has been assumed that tar and light oils are being sold, as is generally done by plants of small and medium capacity.

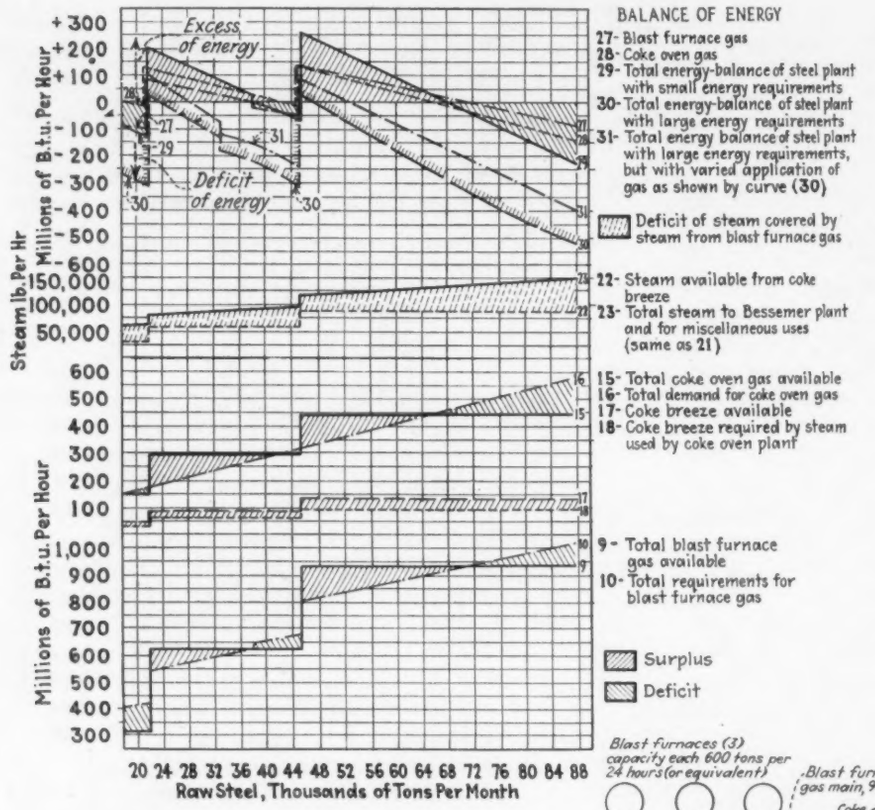
On the basis of the foregoing steel plant conditions, the complete tables of the gas and power requirements and distribution were computed and the complete energy structure of the plant developed in all details, as shown in the summary graph form, for a raw steel production of from 18,000 to 87,300 tons per month (abscissa). The ordinates represent mainly the energy in B.t.u. per hour, as they are delivered and consumed at an average rate and represent also, to a small extent, steam volumes in pounds per hour. By imposing the curves of energy requirements over the curves of energy available the balance is drawn of the energy of each group and of the entire energy complex and made plain by shading

of the respective areas, thus giving a clear representation of the excesses and deficits of energy of the plant when operating as a self-contained unit.

The clear conclusions from this summary graph are: (1) The demand and supply of blast-furnace gas practically never balance, except at a production of about 38,000 and of 71,000 tons per month. There are great deficits of energy at some rates of operation and great surpluses of energy at other rates of production. The first is to be covered by auxiliary firing, usually inefficient; the latter will be wasted. (2) The balance in the coke-oven gas, available and used, is established but three times, at about 18,000 tons, at 38,000 tons and at 66,000 tons; as indicated by the shaded areas, the surplus and, thereby, the wasting of the coke-oven gas is at times very large. (3) These unbalanced conditions in the supply and demand of these two gases are still more pronounced when the balance of the complete energy structure is drawn (see upper group of curves), amounting at times to a deficit of energy of about 220,000,000 B.t.u. per hour and to a surplus of energy of about 265,000,000 B.t.u. per hour.

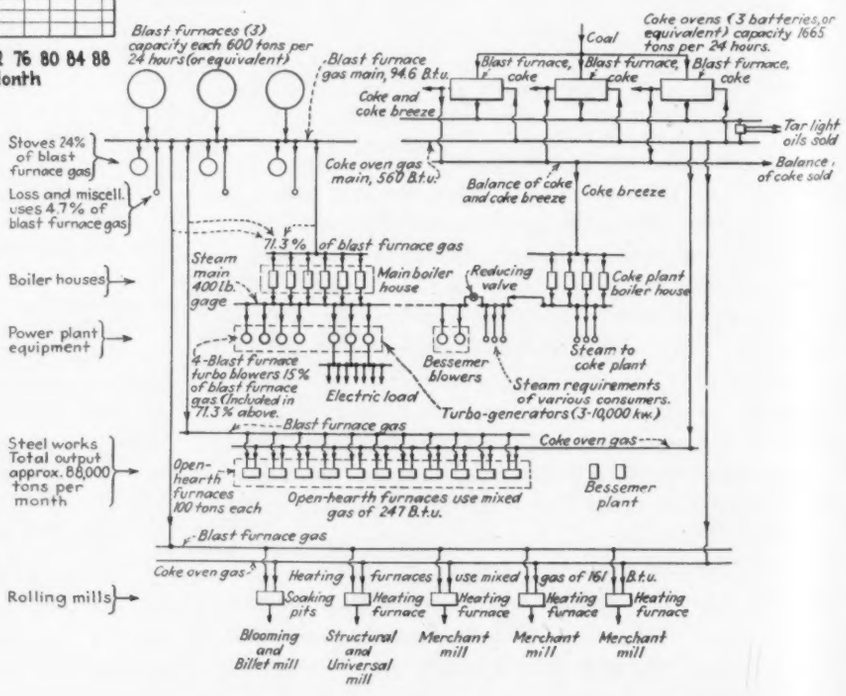
While the foregoing conclusions apply to a plant with small energy requirements (curves 1*a* and 1*b* earlier noted), a special case might consider a steel plant which has large energy requirements for rolling mills and heating furnaces, as shown by curves 2*a* anl 2*c* (page 449), thus representing approximately the upper limit of energy requirements. The balance of this case is represented by curve 30 of the figure. It is readily seen that there are very small surpluses of energy in the entire structure occurring at only two rates of operations, which surpluses can be, therefore, neglected. On the other hand, the deficits of energy are very large, practically at the entire rate of production of from 18,000 to 87,300 tons per month, which must be covered by the use of coal or oil, or by the purchase of gas or electric power.

Another case might be taken as to the general large energy requirements of the plant, still assuming the use of straight coke-oven gas in the open-hearth furnaces at an average rate of 4,560,000 B.t.u. per ton of steel and also the utilization of the waste gases from these furnaces in waste heat boilers. A certain excess of steam of 200 lb. pressure per square inch has been offset by its utilization in the stages of the steam turbo-generators.


BALANCE OF ENERGY
27- Blast furnace gas
28- Coke oven gas
29- Total energy-balance of steel plant with small energy requirements
30- Total energy-balance of steel plant with large energy requirements
31- Total energy balance of steel plant with large energy requirements, but with varied application of gas as shown by curve (30)
Deficit of steam covered by steam from blast furnace gas
22- Steam available from coke breeze
23- Total steam to Bessemer plant and for miscellaneous uses (same as 21)
15- Total coke oven gas available
16- Total demand for coke oven gas
17- Coke breeze available
18- Coke breeze required by steam used by coke oven plant
9- Total blast furnace gas available
10- Total requirements for blast furnace gas
Surplus
Deficit
Excess of energy
Deficit of energy
Steam lb. Per Hr
Millions of B.t.u. Per Hour
Millions of B.t.u. Per Hour
Raw Steel, Thousands of Tons Per Month

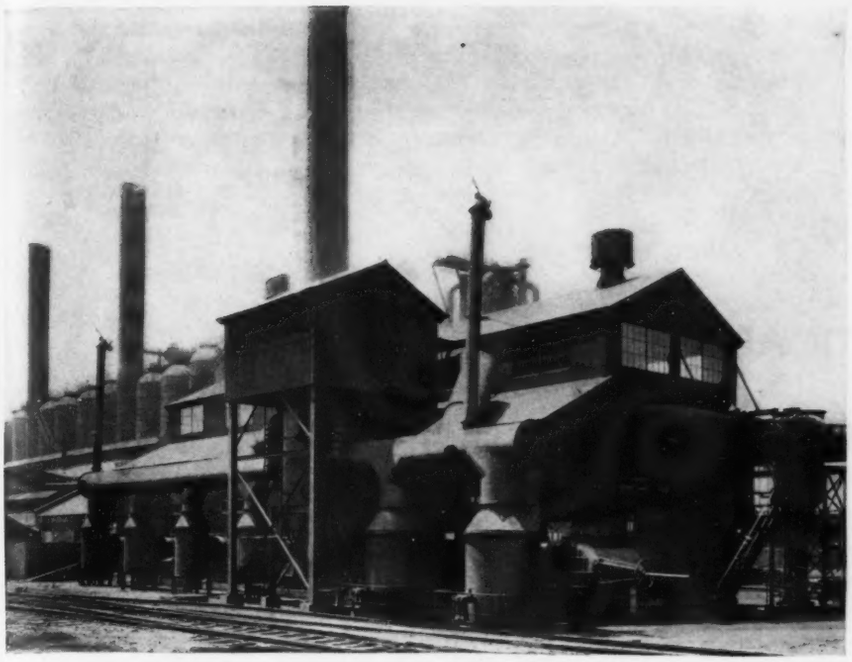
Structure of "ideal" steel plant

This diagram shows energy production and utilization in a steel plant that is self-contained from the energy standpoint. Fullest use is made of by-product gases and electric power is locally generated.


Blast furnaces (3) capacity each 600 tons per 24 hours (or equivalent)
Blast furnace gas main, 94.6 B.t.u.
Coke ovens (3 batteries, or equivalent) capacity 1665 tons per 24 hours.
Coal
Blast furnace, coke
Coke and coke breeze
Tar light oils sold
Balance of coke sold
Stoves 24% of blast furnace gas
Coke oven gas main, 560 B.t.u.
Balance of coke and coke breeze
Coke breeze
Loss and miscell. uses 4.7% of blast furnace gas
71.3% of blast furnace gas
Steam main 400 lb. gage
Main boiler house
Reducing valve
Coke plant boiler house
Boiler houses
Power plant equipment
4-Blast furnace turbo blowers 15% of blast furnace gas (Included in 71.3% above.
Bessemer blowers
Steam to coke plant
Steam requirements of various consumers.
Electric load
Turbo-generators (3-10,000 kw.)
Blast furnace gas
Coke oven gas
Steel works Total output approx. 88,000 tons per month
Open-hearth furnaces 100 tons each
Open-hearth furnaces use mixed gas of 247 B.t.u.
Bessemer plant
Blast furnace gas
Coke oven gas
Heating furnaces use mixed gas of 161 B.t.u.
Soaking pits
Heating furnace
Rolling mills
Blooming and Billet mill
Structural and Universal mill
Merchant mill
Merchant mill
Merchant mill

Energy complex of "ideal" steel plant

Although the plant here diagrammed may be "ideal" from the standpoint of design for heat economy within the plant, it is far from ideal in absolute economics.



Blast furnace gas-cleaning plant

The energy balance of this structure is shown by line 31 of the graph. It is readily recognized that there is still a great deficit of energy, practically along the entire line from 18,000 tons to 87,300 tons per month.

As a conclusion, it can be stated, first, that modern steel plants which are operated as separate units without ties to any other energy systems can practically never have balanced conditions of supply and demand of by-product energy. Therefore, the use of auxiliary fuel must be resorted to at certain periods, and the wasting of energy takes place at other times. Second, that an average line between the limiting curves 29 and 30, for plants with small and large energy requirements, shows that a deficit of energy prevails in the entire energy structure, practically along the entire line from 18,000 to 87,300 tons per month.

Valuation of fuels and their costs

The conception that the fuels and waste heat which are available as by-products in iron and steel plants do not "cost" anything has been given up since the war. If blast-furnace and coke-oven gas were not available within a steel plant corresponding amounts of other fuels would have to be purchased. Therefore, these gases, as well as waste heat in any form, have a definite fuel value as long as the demand for energy is equal to or exceeds the supply of energy within the plant. However, if there is a surplus of energy, that surplus represents only such a value as may be obtained through its sale.

Since the degree of the balance between the demand for energy and the supply of energy varies constantly, and since, therefore, the surplus is difficult to determine under actual plant conditions, a definite value is generally assigned to each kind of by-product fuel, which value is dependent mainly on the cost of coal, including certain factors. This practice is being applied particularly to comparative calculations. In this study the valuation and cost of the fuels have been referred to 1,000,000 B.t.u. (or 10 therms) and to such a condition or stage of preparation that the fuel can be readily utilized. According to the general underlying principle of the study, modern conditions and installations have been assumed, of sufficient capacities to correspond with the typical steel plant.

The valuations of all fuels, including fuel by-products in the steel plant and commercial fuels purchased outside, as well as of the most important mixtures, were calculated. The calculations included fixed charges on equipment, operating expenses and other factors and resulted in assignments of value to all by-product and purchased fuels as functions of plant production in tons of raw steel per months. Detailed discussion of this fuel analysis is not possible within the space limits of this article.

Suffice it to say that cleaned blast-furnace gas ready for use commands a value of from 19.3 to 20.5 cents and coke-oven gas of from 32.1 to 40 cents per 1,000,000 B.t.u. when used in open-hearth furnaces, the variation depending on the rate of plant operation. This value of coke-oven gas holds only for the volume required by the open-hearth furnaces and drops to from 29.8 to 37 cents; i.e., to the value which it commands for heating furnaces. Here, also, the significance of the blast-furnace gas for the underfiring of coke ovens, rather than for the generation of electric power, should be mentioned, whereby coke-oven gas is being liberated at a low cost of from 24.7 to 27.1 cents per 1,000,000 B.t.u. By this means blast-furnace gas can be raised, if sold to the gas utility, to a higher plane of economic value than it might command for the local generation of electric power. Further, there is scarcely any reason why the use of blast-furnace gas for heating and melting is less profitable than for producing a supply of electric energy.

Having determined the energy requirements of the

Table of Steel Plant Electric Power and Related Costs

Production, Tons Raw Steel	Kw.-Hr. Required per Month	Fuel Cost (Cents per Kw.-Hr.)	Fixed Charges (Cents per Kw.-Hr.)	Total Cost (Cents per Kw.-Hr.)	Total Cost of Electric Power (Dollars per Month)	Production Use Costs* (Dollars per Month)	Total (Dollars per Month)
33,100	4,983,000	0.350	0.796	1.279	63,800	139,200	203,000
38,000	5,323,000	0.348	0.745	1.215	64,700	147,300	212,000
43,200	5,693,000	0.390	0.695	1.197	68,200	154,800	223,000
47,200	5,958,000	0.375	0.665	1.147	68,400	167,600	236,000
52,100	6,278,000	0.370	0.631	1.104	69,300	175,700	245,000
57,200	6,623,000	0.363	0.598	1.06	70,300	183,700	254,000
62,200	6,938,000	0.357	0.571	1.023	71,000	192,000	263,000
67,200	7,278,000	0.352	0.544	0.988	71,900	201,100	273,000
72,200	7,558,000	0.351	0.524	0.964	72,900	209,100	282,000
77,300	7,848,000	0.345	0.504	0.936	73,400	217,600	291,000
82,200	8,223,000	0.343	0.482	0.91	74,800	227,200	302,000
87,300	8,553,000	0.341	0.463	0.887	75,800	237,200	313,000

* Cost of blast furnace blowing Bessemer blowing steam for miscellaneous uses, operation of heating and open-hearth furnaces.

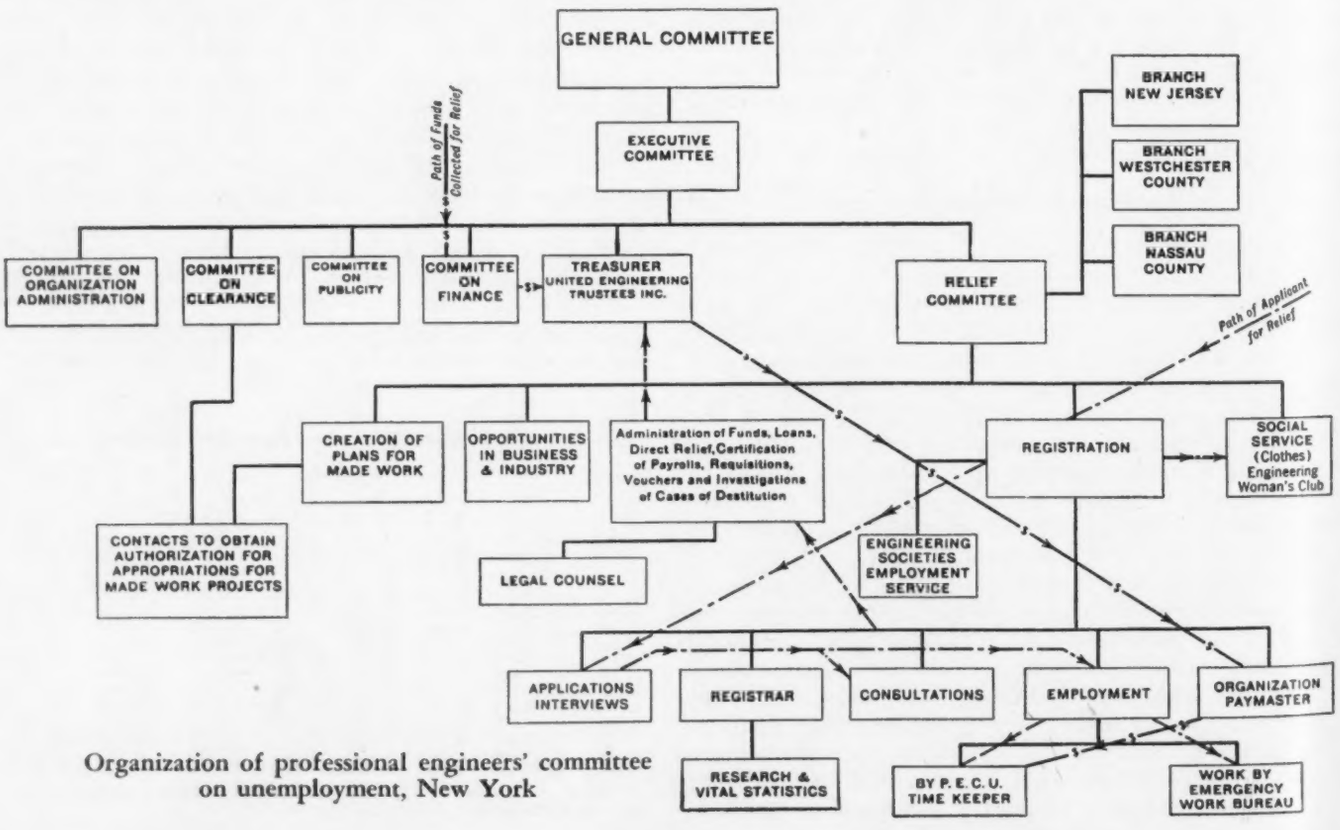
various energy consumers of the typical steel plant and the valuation and cost of the various fuels and mixtures, the cost of the electric power in its own station has been calculated and a general cost exhibit of the energy structure established. Without going into detail of the numerous main items constituting the cost exhibit of the entire energy structure of the typical "isolated" steel plant, it suffices here to emphasize a few items and the grand total sum as given in the table, which will serve later as a comparison with the cost exhibit of a steel plant, the energy structure of which is blended into those of the electric and gas utilities. This blending of energy structures together with the various forms of energy exchange between the three groups will be discussed in a later article of this series on regional energy co-ordination.

▼ ▼ ▼

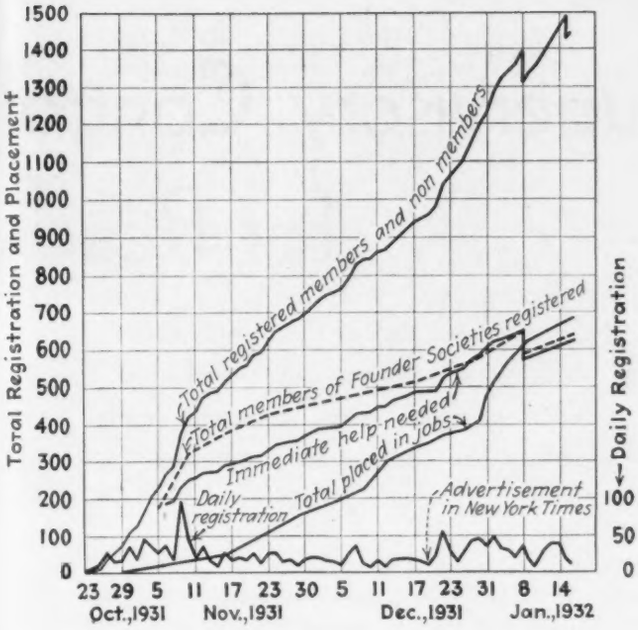
Unemployment Committees Aid 696 Engineers in New York

PROFESSIONAL engineers in the Metropolitan New York district have not been willing to allow their unfortunate brothers to reach the stage of destitution at which regularly constituted relief authorities will give aid. Between October 23, 1931, and January 19, 1932, they have provided work for 696 professional engineers, of whom half are not members of the four founder societies. Of the total number assisted nearly 15 per cent were electrical engineers, the remainder being mechanical, civil, mining or metallurgical engineers. Some 1,400 engineers have contributed $70,000 for the work and about 60 engineers are rendering volunteer service on the "Professional Engineers' Committee on Unemployment." This committee, the organization chart of which is reproduced, confines its help to professional engineers in the metropolitan section, but, as indicated before, does not limit its aid to members of the founders societies. All money collected for relief work is used for that purpose alone; administration expenses come from other sources.

Preference in employment is always given to those in immediate need. Should an applicant be in immediate need of clothing it is made available by the social service committee. Legal help and financial help in the form of non-interest-bearing loans are given when conditions warrant it. Arrangements are made for those who are not in particular financial stress, but suffering from severe mental depression from loss of occupation, to attend Columbia engineering courses without fees. One committee maintains constant contact with industrial and commercial enterprises to ascertain where their applicants may fit in. Another committee makes plans for creating new jobs.


GENERAL COMMITTEE
EXECUTIVE COMMITTEE
Path of Funds Collected for Relief
BRANCH NEW JERSEY
BRANCH WESTCHESTER COUNTY
BRANCH NASSAU COUNTY
COMMITTEE ON ORGANIZATION ADMINISTRATION
COMMITTEE ON CLEARANCE
COMMITTEE ON PUBLICITY
COMMITTEE ON FINANCE
TREASURER UNITED ENGINEERING TRUSTEES INC.
RELIEF COMMITTEE
Path of Applicant for Relief
CREATION OF PLANS FOR MADE WORK
OPPORTUNITIES IN BUSINESS & INDUSTRY
Administration of Funds, Loans, Direct Relief, Certification of Payrolls, Requisitions, Vouchers and Investigations of Cases of Destitution
REGISTRATION
SOCIAL SERVICE (Clothes) Engineering Woman's Club
CONTACTS TO OBTAIN AUTHORIZATION FOR APPROPRIATIONS FOR MADE WORK PROJECTS
LEGAL COUNSEL
ENGINEERING SOCIETIES EMPLOYMENT SERVICE
APPLICATIONS INTERVIEWS
REGISTRAR
CONSULTATIONS
EMPLOYMENT
ORGANIZATION PAYMASTER
RESEARCH & VITAL STATISTICS
BY P. E. C. U. TIME KEEPER
WORK BY EMERGENCY WORK BUREAU

Organization of professional engineers' committee on unemployment, New York



Relation of registrations to help rendered

Although relief has been given to virtually all who are in desperate need, the registrations are increasing, but contributions are not increasing proportionately. Also, New York City has been compelled to curtail its contributions to general unemployed relief work. The probable result will be that the committee will find its work increasingly difficult. Arrangements are being made to call personally on some 11,000 engineer members of the founder societies who have not yet responded to appeals for contributions.

▼

Breakers Used Exclusively for Feeder and Branch Circuits

The question of whether feeder and branch circuits should be protected by fuses or circuit breakers came up in designing the new service center of the Syracuse Lighting Company. Eighty feeders and 1,700 branch circuits were involved.

Although the cost of breakers was more than fuses, the former were used throughout for the following reasons, according to Fred J. Brown, lighting department; (1) Time of circuit outage would be reduced. Circuit outages are often expensive and inconvenient if not quickly remedied. The correct man or proper fuse is not always immediately available. No particular training is necessary to throw small circuit breakers to correct position. (2) Expense of fuse replacement would be eliminated. Over a period of ten years this would be a considerable item for 80 feeder circuits and 1,700 branch circuits. (3) Better circuit protection could be afforded feeders as breaker could be equipped with high calibration and inverse time element features to absorb high starting currents for motors or type C incandescent lamps and at the same time afford accurate running protection. (4) As the complete circuit breaker protection of feeders and branch circuits in commercial buildings is an advanced step in modern building electrification, the power company should lead the way in this regard.

▼

Sunburn—Tan—Health

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Exposure to summer sunlight and to ultraviolet radiation from certain artificial sources for the purpose of curing illness or maintaining health results in sunburn (erythema) and in tan (pigmentation). These are visible manifestations of the effects of ultraviolet radiation. The biological benefits are not immediately revealed and usually cannot be appraised visually. The association of reddening and tanning of the skin with exposures to natural and artificial sunlight leads to the belief that these are necessary in order that the human body may be benefited. No scientific proof is available to support this belief.

Erythema is a destructive action which is produced by the same radiation which has been proved of value in building and maintaining health. It draws upon the resources of the repair forces in the human body. Certainly serious degrees of it should be avoided. Minimum perceptible erythema and occasionally a vivid reddening are useful in establishing limits of dosage or exposure. We have positive evidence of physiological benefit without the production of erythema. The use of artificial sunlight for general lighting must be sold on the basis of sub-erythemal exposure and benefit.

The depth to which ultraviolet radiation penetrates the skin decreases as the wave length decreases. The best midsummer sunlight contains only the long-wave biologically active radiation. It penetrates more deeply than the short-wave beneficial radiation. It penetrates through the horny layer and basal cells of the skin to the network of blood vessels. This is the depth required to produce much pigmentation. Therefore, sunlight produces a better tan for a given erythema than the radiation from a quartz-mercury arc whose short-wave ultraviolet does not penetrate as deeply.

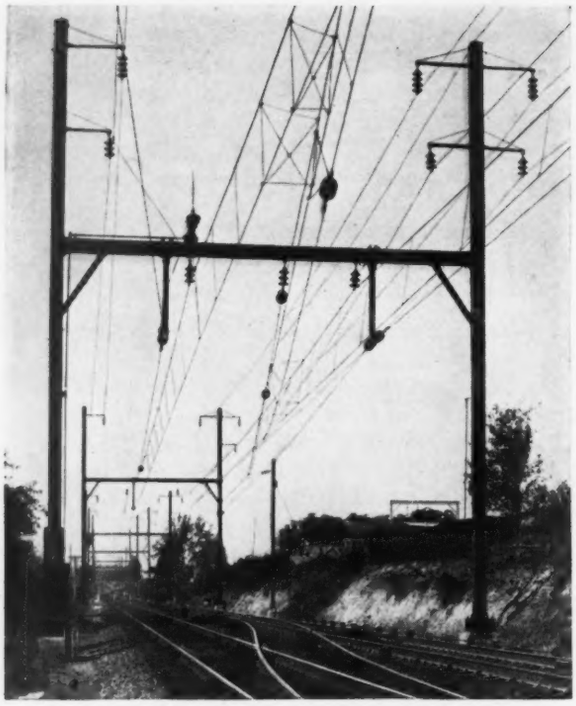
The negro skin produces pigmentation without the aid of ultraviolet radiation. The albino skin cannot produce pigment even with the aid of these rays. The normal white skin lies between these two. The tan is a protection against reasonable overexposures. However, it does not close the door to the beneficence of ultraviolet radiation. Colored babies are easily cured of rickets—adequate proof indeed. For protection, nature has provided large factors of safety. The relative times or intensities necessary to produce four degrees of erythema are

Minimum perceptible	1
Vivid, producing moderate tan	2.5
Painful burn, fairly permanent tan	2
Blistering, seriously destructive	10

This range may also be extended by aiming to have a sub-erythemal dosage the maximum produced under normal time of exposure and intensity of radiation. It is further extended by the protective action of pigmentation. This range in factor of safety makes lighting for health and vision possible.

Supervisory Control for Reading E

Selected because of flexibility, speed with which system can be cleared, freedom from error, economy and ability to concentrate operation at one point



Sectionalizing point of trolley circuit

Note air-break switch on crossbeam of catenary structure. It is motor-operated through rod extending down left-hand column. Supervisory control apparatus is mounted in numbered cabinet at left.

THE power distribution system for the Reading Company's new suburban electrification is entirely dependent upon supervisory control for its operation. There are no operators or maintenance employees at any of the substations and no switching operations are performed by signal tower operators or other employees. The installation is the largest of its kind and controls from a single power dispatcher's office ten main substations and sixteen intermediate switching stations with a total of 327 devices. Future extensions will more than double the present size of the installation; the system was laid out with this in mind.

There are three methods of controlling switches and circuit breakers on an electrified railroad:

1. By telephone instructions to operators at substations.
2. By telephone instructions to tower men or station attendants at the nearest interlocking tower or stations from which the devices are operated by local control circuits.
3. By supervisory control.

The first method was not considered as it would have involved the expense of operators.

The second method had the disadvantage that there were no signal towers at certain locations where switches are provided. This method also involves transmitting switching orders and receiving reports over the telephone, with resultant delay and possibility of error, and does not furnish the power dispatcher constant indication of the condition of all devices on the system.

The third method, using supervisory control, provides maximum speed and flexibility of operation, eliminates the use of other employees except the power dispatcher and places the operation of the entire system at the power dispatcher's fingertips. It also has the advantage of eliminating all divided responsibility.

While the use of supervisory control extends back more than ten years, previous installations and equipment have not always shown the required reliability of operation. There has, however, been a very rapid development in this type of equipment and the manufacturers have developed several different types which have been used and superseded by better equipment. It was decided that the latest types embodying adequate protective equipment would give satisfactory service and the results so far obtained fully bear this out.

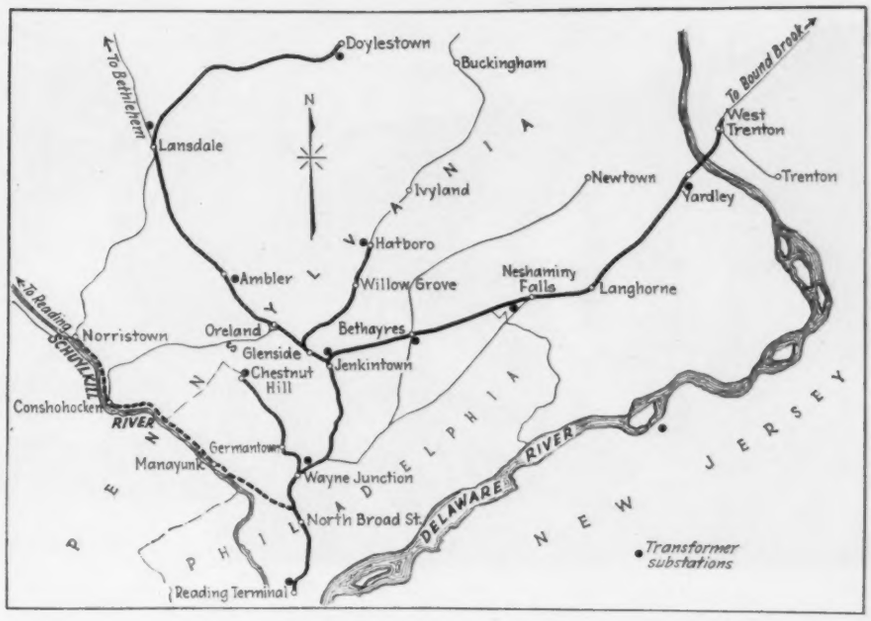
The general layout of the suburban lines, on which 70 route-miles and 167 track-miles have been electrified, is shown on the accompanying map. The power dispatcher's office is located at Wayne Junction, at which point the railroad company obtains its entire power supply for the electrification. The car shop and electrical maintenance headquarters are also located here. This centralizes all the operating and maintenance activities in connection with the electric operation. The ten substations which the dispatcher controls are shown on this map. The sixteen switching stations are situated at intermediate points along the line where the catenary system is sectionalized by means of motor-operated disconnecting switches. Each switch and station consists simply of a cabinet housing the control relays and small local storage battery, the switches themselves being outdoor pole-type top disconnecting switches mounted on the catenary structures.

Several branches of the railroad radiate from Wayne Junction. It was specified that the control system should be such that all the devices and substations on each branch should be controlled by a single set of line wires. The two latest types of equipment, i.e., the Westinghouse "visicode" and the General Electric "synchronous selector," ordinarily require separate sets of line wires to each station, but the manufacturers met the railroad's requirements by developing circuits so that this method of operation could be obtained. The initial installation is operated over five separate circuits and the equipment used is as follows:

A—Wayne Junction to Reading Terminal, Westinghouse "visicode."
B—Wayne Junction to Chestnut Hill, Westinghouse.
C—Wayne Junction to Lansdale and Hatboro, Westinghouse.
D—Wayne Junction to Jenkintown and Yardley, Westinghouse.
E—Wayne Junction to Bethayres and Neshaminy Falls, General Electric "synchronous selector."

ng Electrification

By G. I. WRIGHT
Chief Electrical Engineer, Reading Company



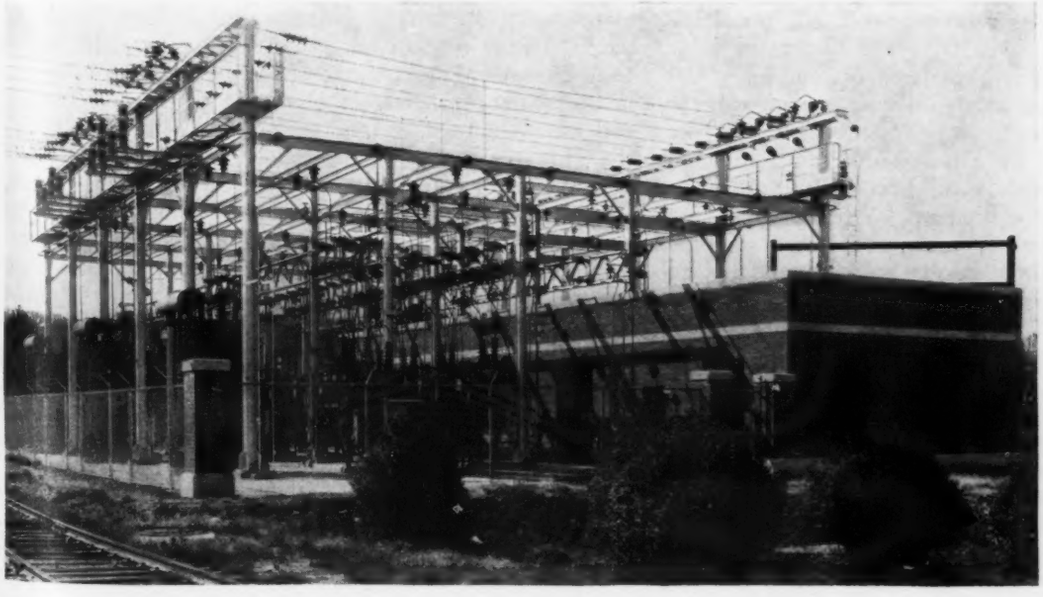
Location of main substations on Reading electrification

The power dispatcher's control and supervisory equipment, mounted on a semi-circular benchboard, constitutes the most interesting equipment. The horizontal section carries the control and supervisory escutcheons; the vertical section bears the meters and illuminated system diagram. Illuminated-dial-indicating meters are connected to the Wayne Junction substation circuits and outgoing lines; a wattmeter and power-factor meter indicate system conditions. Circuit breakers and trolley sectionalizing switches are represented in the system diagram by translucent colored and numbered cards, illuminated from behind when the corresponding devices are closed. The number corresponds to the switch number and the color to the voltage of the circuit. The lamp illuminating these cards is connected in parallel with the red lamp on the corresponding control escutcheon. Labels on the escutcheon plates are also colored to represent the voltage of the circuit and aid location. Supervisory control relays are mounted on vertical swinging panels at the rear of the control bench.

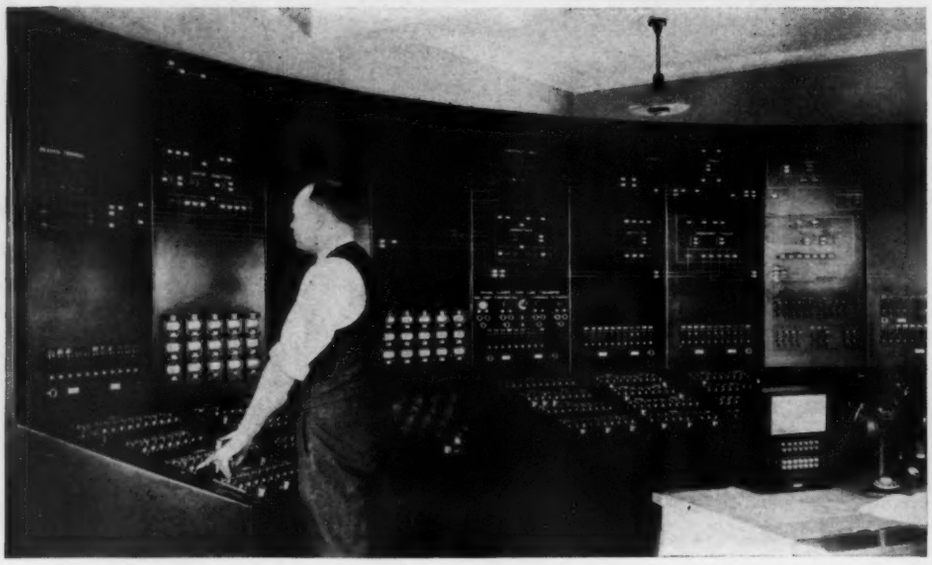
Besides giving the power dispatcher a continuous indication of the position of every device, the supervisory control sounds an alarm whenever a device changes position. To aid the dispatcher in determining which device has changed position, three lamps light: (1) a chain lamp indicating which supervisory control line is sending impulses; (2) the lamp indicating the sending station, and (3) a disagreement lamp on the individual escutcheon for the device which has changed position.

Should the dispatcher desire to close a device which has automatically tripped, he merely selects the corresponding supervisory control, presses a button on the escutcheon, turns the control key to the close position and presses the master control key. When the device has closed, the indicating lights notify the dispatcher that the operation has been performed. The tripping function is performed in a similar manner.

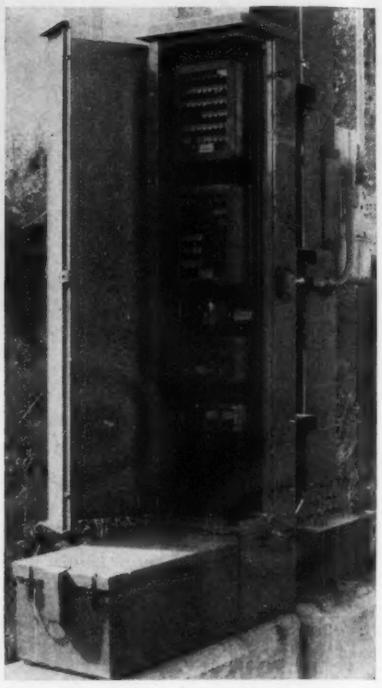
In addition to being controlled over the supervisory control system, all circuit breakers in the various substations are controlled locally. The control circuits have been so designed that if the power dispatcher trips a device by supervisory control it is impossible to close the device locally. Furthermore, a device which has been tripped locally cannot be closed by the power dispatcher by supervisory control. However, when the device is in the closed position it can be tripped either locally or by supervisory control. This scheme affords protection for operation and maintainence, since if a substation maintenance man has tripped a breaker locally to work upon



One of ten attendantless substations supplying Reading Railroad



Power dispatcher has control and supervision of apparatus in ten substations and sixteen switching stations



Method of housing switching station supervisory control

Battery and charging equipment are housed in lower compartment. Mechanism for operating trolley sectionalizing switch in back of column.

it, even the power dispatcher through error cannot close it. Similarly, if the dispatcher has tripped the breaker to give clearance for a line crew, it is impossible for the substation maintenance man to close the breaker in error. Protection is also afforded against closing the breaker by unauthorized persons.

The supervisory control system also provides indication of the condition of all batteries on the system, transformer temperatures and permits resetting the bus differential lockout relays. Indication of battery condition is obtained by means of a voltage relay which has contacts in the supervisory control circuits. When the voltage reaches a predetermined low value a red indication is given, and when the voltage returns to normal a green indication is given. When the red indication is received the dispatcher realizes that the charging source has probably been lost and a man is sent out to make repairs.

Transformer temperature indication is afforded by means of a "Mercoid" temperature switch placed on each transformer, which has contacts in the supervisory control circuits, to give an alarm when the temperature rises to a predetermined high point and give an indication when the temperature has returned to a safe operating value.

Where the substations have control buildings the supervisory control equipment is mounted directly in line with the control and relay switchboard. At the switching stations there were no buildings available, so it was necessary to provide weatherproof outdoor housing for the supervisory equipment. An accompanying illustration shows a typical housing mounted against one of the H-frame, catenary structures so as not to decrease the railroad operating clearance. The batteries and charging equipment are mounted in the lower portion of the housing and the relay panel in the upper part. Energy to supply the rectifier charger is obtained from the 100-cycle railroad signal power line, which also supplies energy for operating the motors that open and close the trolley sectionalizing switches. The trolley-sectionalizer operating mechanism is mounted in a separate cabinet and connected with the supervisory control cabinet by a cable. Parkway cable is employed and is buried along the railroad right-of-way. Where there are several switches at or near the same location the supervisory control cabinet is installed at a point which is convenient to all of them.

Power for operating the supervisory control equipment is provided, in all cases, by a separate ungrounded battery supply. The battery is floated on the line with either a motor-generator set, where the load is heavy, or a rectifier where the load is light, and the charging rate is adjusted to float the battery at between 2.15 and 2.2 volts per cell. To minimize grounds and trouble in the supervisory control battery circuits indication interposing relays are employed; the use of these keeps the supervisory control battery circuits out of the substation yard. In the case of all oil circuit breakers the indication interposing relays are so connected as to be normally picked up through the breaker trip circuit and trip coil when the breaker is in the closed position. Thus, if the trip circuit or trip coil develops an "open," the supervisory control equipment will send in an "open" indication. If attempts to close the device are unsuccessful the dispatcher will send a maintenance man to the station to locate the trouble. By this method the trip circuit and coil are automatically supervised. Where motor-operated disconnecting switches are involved the indication interposing relay is normally picked up when the switch is closed; therefore, should the 100-cycle supply from which the switch is operated be lost, the dispatcher will get an indication thereof.

The supervisory control wires are carried along the railroad right-of-way by aerial and underground communication cables used jointly for railroad, telephone, telegraph and supervisory control circuits. The aerial cable has two steel tapes over the lead covering. To

guard against line wire trouble a completely connected spare set of line wires is provided for each system and arrangements made so that the power dispatcher can transfer control from one set to the other by merely pressing a button and throwing a switch on the supervisory control desk. This operation sends an impulse over the line wires to which the equipment is to be transferred and operates a line transfer relay at each station, thereby connecting the equipment to the desired lines. Where there are two communication cables available, one set of line wires is located in each cable.

A thorough study was made to determine the effect of induction upon the operation of the supervisory control equipment and also to select methods of draining the induced currents. Calculations indicated that it would be necessary to drain the lines and two types of drainage have been employed. One consists of resistance connected between each line wire and ground at the ends of the line and at strategic intermediate locations. The other method employs a resonant drain (resonant to 25 cycles), consisting of a reactor and condenser connected in series between each line wire and ground. This type of drainage is used at each substation. In addition to the drainage equipment standard supervisory control protector tubes are connected between each line wire and ground at every station. They relieve the line wires of voltages in excess of 300 volts which may develop during a lightning storm, from a cross with a high-voltage line, or from an exceedingly severe short circuit. The tubes are of the vacuum type and are self-recovering when the high potential is reduced.

A few minor difficulties were encountered during the testing period, such as trouble from blown fuses, and the necessity for readjusting relays after shipment. Considerable annoyance was experienced at first from voltage indications being sent in from supervisory control equipment in the weatherproof housing along the right-of-way each time a train passed the control housing. The cause was attributed to vibration. By setting the voltage relays with a slightly greater margin no further difficulties were encountered.

Tests consisting of load and short-circuit induction were conducted to determine the efficacy of the drainage equipment with normal and abnormal set-ups. Load induction was simulated by tying the trolley to the rail at the end of the line and building up voltage until the desired current was circulated. Current up to 1,500 amp. was stub fed over 14 miles of trolley-rail circuit and no difficulties in the operation of the supervisory control equipment were experienced. No trouble was obtained from full-voltage short circuits when the lines were fed in the same manner. The successful results obtained can be attributed to two causes — one, the adequacy of the drainage equipment and, two, the use of steel armored cable.

Taxes and Interest Account for Third of Utility's Costs

	—Cents per Kilowatt-Hour Sold—		
	Minimum	Average	Maximum
Production	0.041	0.3736	3.238
Transmission	0.001	0.0415	0.436
Distribution	0.008	0.0847	1.577
Utilization	0.004	0.0213	0.431
Commercial	0.003	0.0619	0.673
New business	0.001	0.0213	0.322
Depreciation	0.032	0.1549	1.521
General and miscellaneous	0.015	0.1469	10.869
Total operating expenses	0.118	0.9061	10.869
(After miscellaneous credits)	.....	0.9024	.....
Taxes	0.018	0.2127	1.054
Bad debts	0.002	0.0042	0.142
Interest	0.019	0.2967	2.006
Total cost per kilowatt-hour on all energy available for sale	.....	1.416	.....

▼

New Hampshire Utility Costs Analyzed

Significant unit values are derivable from a comprehensive survey made by the New Hampshire Public Service Commission of the operating and fiscal experience of 52 operating divisions and single-division electric companies under its jurisdiction. The data are for 1929, the last full year for which the information was available when the study was undertaken. There were 124,098 customers of all classes embraced in the study and of these 100,020 were domestic or residential users.

Several companies are wholesalers only and data pertaining to them are excluded from the figures herewith abstracted so that the "per customer" figures and ratios would not be unduly distorted. On the other hand, several of the distributing companies were small, a few actually having less than 100 customers. The latter are, of course, included in order that a state-wide average of mixed rural and urban territory could be presented.

The 100,020 residential users consumed 35,633,597 kw.-hr., which means an average of 356 per customer per year. The corresponding monthly average bills ranged from $1.68 to $5.70, the household users therefore paying on the average from 8.49 cents to 15.83 cents per kilowatt-hour in the different communities.

Eighty per cent of the generated and purchased kilowatt-hours originated in hydro-electric plants. Company use of energy amounts to 1.8 per cent and the unaccounted for energy is approximately 17 per cent.

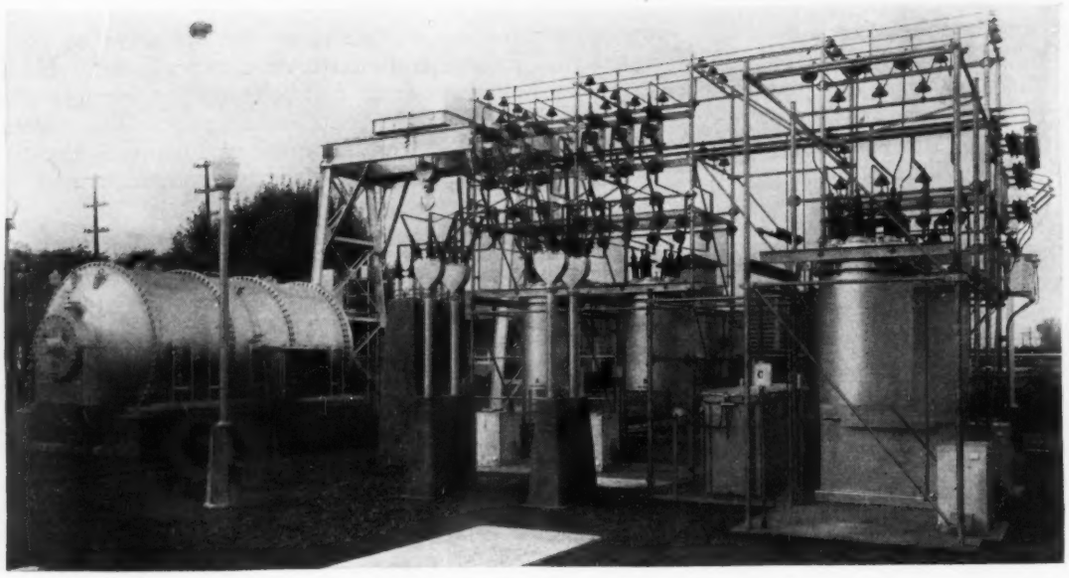
Securities Agree Closely with Book Values

	Minimum	Average	Maximum
Book value of plant per customer, dollars	69.52	327.19	685.17
Outstanding securities per customer, dollars	11.90	325.48	505.59
Reserve for depreciation (per cent of plant value)	0.22	8.66	36.70
Depreciation allowance for year, per cent	0.53	1.85	5.35
Surplus account, per cent	1.53	7.64	66.55
Ratio of gross income after taxes to book value of plant, per cent	0.479	7.909	21.519

(Three companies showed a loss)

Distribution of Output and Revenue

	Total Customers	Per Cent of Kw.-Hr.	Per Cent of Revenue	—Cents per Kw.-Hr.— Min. Aver.	General Aver.	Max. Aver.
Domestic lighting	100,020	6.82	27.52	4.77	8.57	16.75
Commercial lighting	17,198	4.77	16.19	3.96	7.20	14.89
Industrial power	4,840	23.42	21.51	0.67	1.95	11.80
Cooking, heating, refrigeration	856	0.30	0.47	2.54	3.38	19.27
Public building light and power	874	0.66	1.38	2.98	4.47	26.87
Street lighting	239	1.75	5.58	1.77	6.79	20.00
Railroads and railways	7	2.42	0.22	1.22	1.69	2.08
Other companies and miscellaneous	.....	59.86	25.20	0.34	0.89	5.79
		100.00	100.00	Average	2.12	



20,000-Kva. synchronous condenser installation

Hydrogen-Cooled Condenser Reduces Operating Costs

By C. E. SCHNELL

Designing Electrical Engineer
San Joaquin Light & Power Corporation, Fresno, Calif.

MUCH stress is laid on the rising costs of substation construction and all efforts to reduce these costs are well directed. Operating costs also are a large factor in the price of power to the consumer and must be kept to a minimum consistent with good service. In the recent installation of an outdoor type 20,000-kva., 12,500-volt hydrogen-cooled synchronous condenser by the San Joaquin Light & Power Corporation full benefit was taken of the savings in installed cost of outdoor equipment, together with the saving in operating cost due to the low over-all losses of hydrogen-cooled equipment.

Study showed that the installed cost of a conventional type of synchronous condenser requiring an addition to the existing substation building was only slightly greater than the installed cost of the hydrogen-cooled type of condenser. Although the hydrogen unit was considerably higher in first cost of the unit itself, the outdoor features eliminated the need of a building and greatly simplified design and construction. However, on a comparable basis of installed cost the hydrogen-cooled type operates with such reduced losses as to place it in a most favorable position.

The California Avenue substation, where this unit is installed, is a transmission station having two 9,000-kva. transformer banks transforming from 70 kv. to 12 kv. as nominal voltages. The 12-kv. bus is arranged in two sections, each with its transformer bank and group of distribution feeders. Prior to the installation of the synchronous condenser these bus sections were tied together with a bus-tie oil circuit breaker set to relay out ahead of the feeder oil circuit breakers and thus relieve the duty on the latter to that imposed by the short-circuit characteristics of one bank only.

This scheme has been so desirable that the synchronous condenser was therefore arranged to operate on a bus between the two transformer buses and connected to each by suitable oil circuit breakers which serve as the running breakers. These breakers are protected by directional overload relays to remove the condenser from that section of bus which may have feeder trouble. This relieves the feeder oil circuit breaker duty, but still keeps the condenser on the other bus section on which no trouble exists. This is accomplished by leaving the former bus-tie oil circuit breaker open when the condenser is operating.

A study of the one-line wiring diagram illustrates the above and also shows that the unit may be started from either transformer bank. Another feature is the arrangement of source of power for the motor-driven exciter. This consists of a bank of transformers connected directly to the condenser leads without oil circuit breaker but located inside the differential protection of the condenser. Thus the exciter set is started with the same switching that starts the condenser and operates from the same running switches. This has materially reduced costs due to the elimination of a heavy-duty oil circuit breaker for the protection of this bank of transformers.

All equipment is of the outdoor type, except the switchboard equipment and exciter set. These are installed in the existing substation building. A 40-ton

gantry crane with motor-operated hoist and crane travel is installed. This crane not only serves the condenser but is available for handling the station transformers for repairs if necessary.

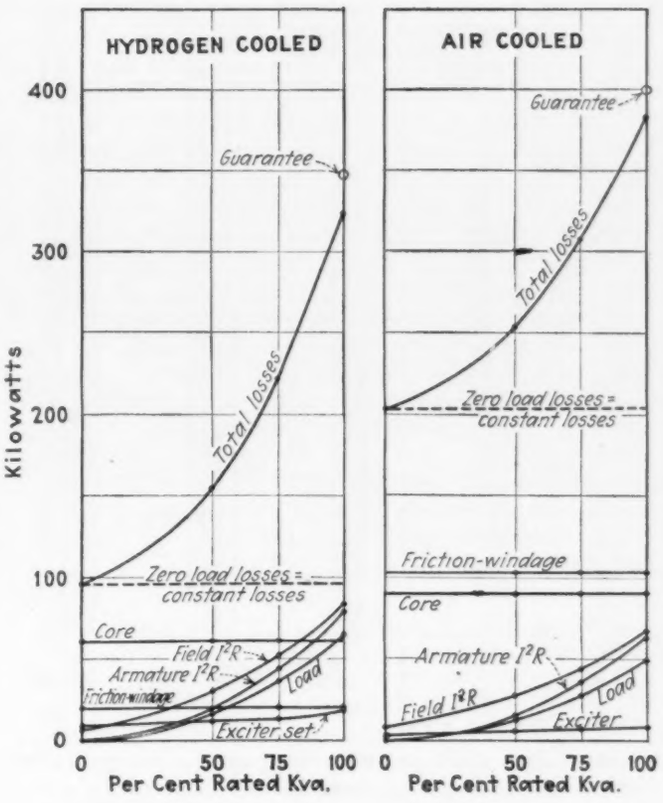
The pit under the unit is the full length and width of the machine and of sufficient size to give ample headroom under the water-cooling pipes. The bearing pressure pumps for starting and an automatic motor-driven sump pump are in the pit, together with the condenser leads and current transformers for differential protection.

Hydrogen purity indicator devices and thermometers for indicating temperatures of cool and warm hydrogen gas and bearings are located in a weatherproof housing on the side of the unit. Surface coolers in each end of the unit extract the heat from the hydrogen gas. Water for these coolers is supplied by motor-driven centrifugal pumps in duplicate and is passed over unit-type cooling towers, three being used in this installation. Make-up water is purchased.

Reduced No-Load Losses—Advantages of hydrogen when used with rotating electrical equipment have been known for some time. No-load losses are constant during the entire time of operation of the equipment and should therefore be evaluated at a high figure. These consist of windage, friction and core losses. The windage loss of a rotating machine is directly proportional to the density of the gas in which it rotates. Hydrogen, which is a gaseous element and the lightest known substance, with a density of only 7 per cent that of air, is particularly fitted to reduce windage losses over those where the machine is operated in air. Reduced windage loss also decreased the amount of heat to be removed from the machine, thus making a further saving in the size of surface coolers required.

Bearing friction loss is the same in hydrogen as in air, with, however, an added benefit in longer life of bearing oil due to its operation in an atmosphere which permits no oxidization.

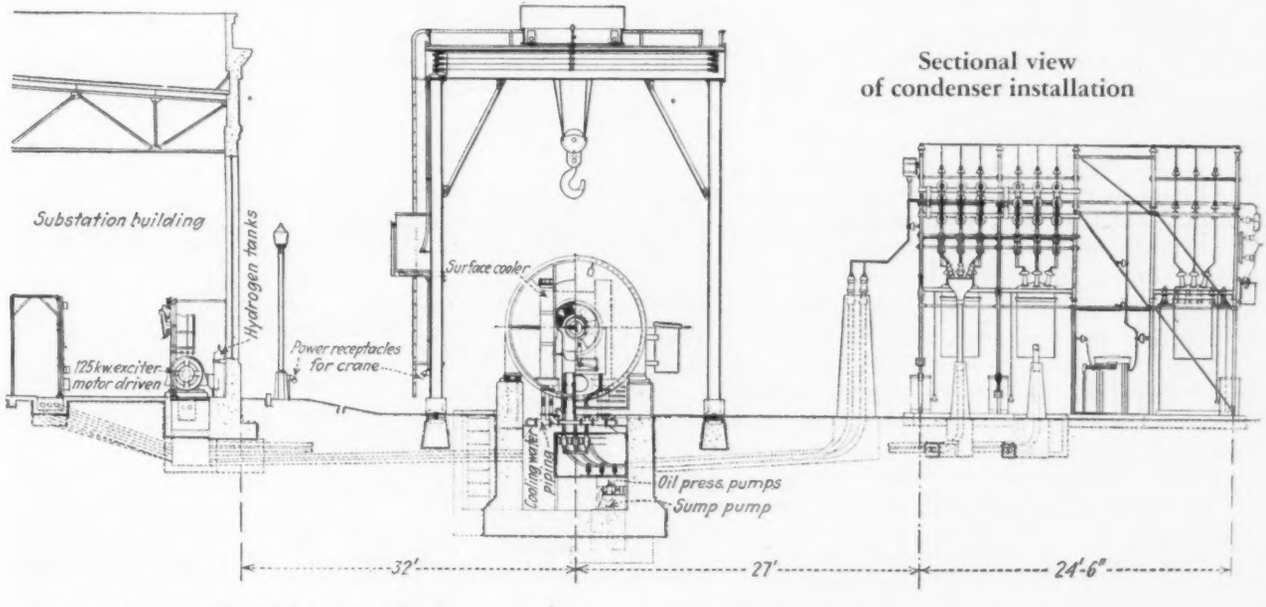
Increased Rating—The thermal conductivity of hydrogen is high in that it conducts heat about 7.5 times better than air. Hence, heat passes across the small spaces between the laminations and in the insulation much more readily than with air cooling. Therefore, with a given surface temperature the copper temperature is less in hydrogen than in air.



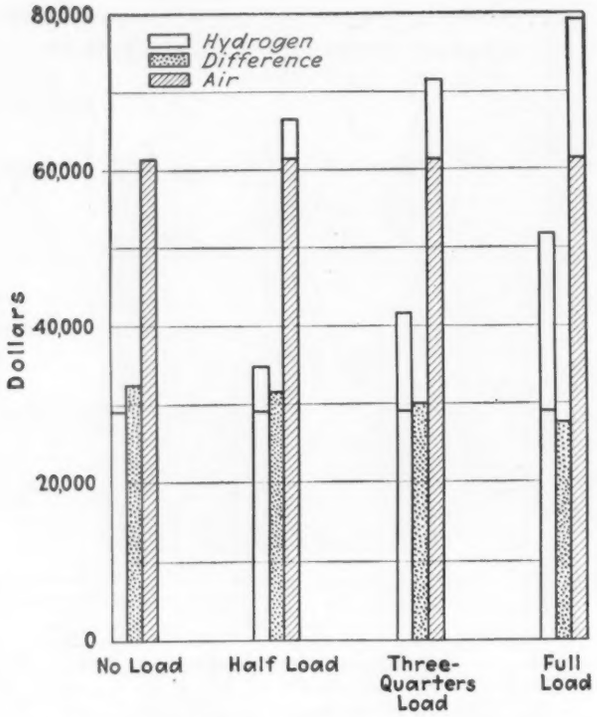
Comparative losses for 20,000-kva. hydrogen-cooled and air-cooled synchronous condensers

Advantage is also taken of the high forced heat convection of hydrogen in that in an atmosphere of hydrogen about 30 per cent more heat can be transferred from heated surfaces than in air with the same surface temperature drop. Thus when the hydrogen comes in contact with the surface coolers more heat can be transferred to the coolers than with air, which permits a smaller surface cooler to be used. The bearing temperature is also less in hydrogen than in air.

With the same load, a machine will run cooler operat-



Sectional view of condenser installation



Evaluation of losses in 20,000-kva. condensers based on $100 per kilowatt for variable losses and $300 per kilowatt for constant losses

ing in an atmosphere of hydrogen than in air, or with the same temperature rise it will carry a greater load than in air. This increase in output from a given machine depends on the hydrogen pressure and the degree of saturation in the magnetic structure and is generally from one-fourth to one-third of the rated output of the machine in air.

Fire hazard is small

Hydrogen, properly controlled, instead of being a hazard is a protection against fire. Since there is no oxygen present in the machine any arc which might occur will be extinguished with a minimum of damage. This absence of oxygen also enables the insulation to retain its flexibility longer, and thus increases its life.

Fears regarding the possibility of an explosion in a hydrogen-filled machine will be quieted when it is realized that no explosion can occur in a mixture of hydrogen and air containing more than 70 per cent, or less than 10 per cent of hydrogen by volume. The explosion range is thus from 10 per cent hydrogen and 90 per cent air as the lower limit to 70 per cent hydrogen and 30 per cent air as the upper limit. The maximum explosive mixture is 35 per cent hydrogen and 65 per cent air.

The use of carbon dioxide gas in scavenging the machine of air when filling the unit with hydrogen or when removing the hydrogen eliminates any possible explosive mixture of hydrogen and air at any time. While in operation, to prevent the possibility of an explosive mixture being obtained, a small pressure above atmospheric is maintained in the machine, so that any leakage will be hydrogen outward rather than air inward. In practice, hydrogen is admitted to the unit when the pressure falls to ½ lb., and when pressure reaches 1½ lb. the supply is cut off, all control being automatic.

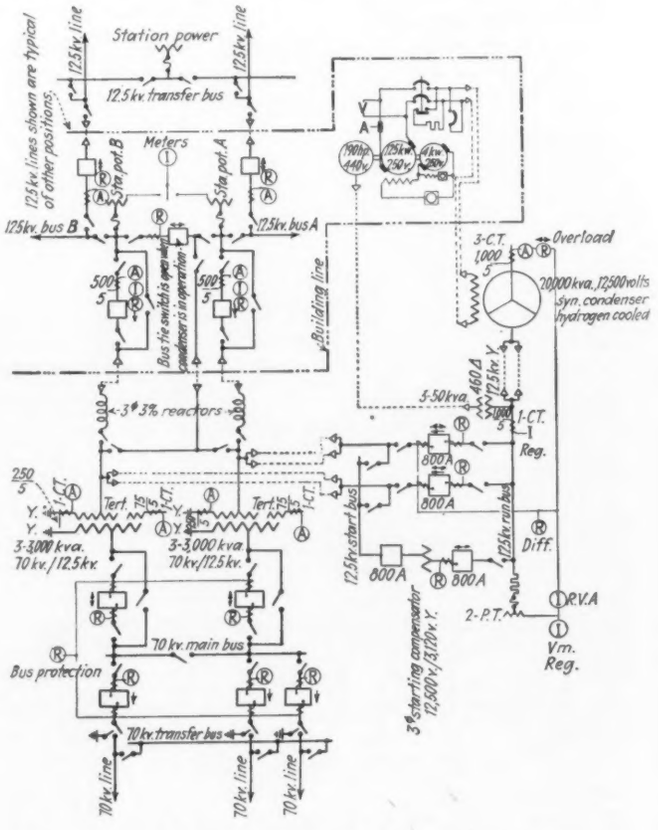
Corona Damage Minimized—The thickness of all armature coil insulation is governed partly by the high-voltage gradient and the formation of corona in the minute spaces of the insulation. It has been demonstrated that damage due to corona is practically eliminated in an atmosphere of hydrogen.

Outdoor Installations—The frame of a hydrogen-ventilated machine is gas-tight and also waterproof, therefore it may be installed outdoors without any additional protection from the weather, with the attendant saving in building costs. Offsetting this saving, additional expenditure for water tightness of foundation and sump pump drainage will be required for outdoor installation.

Quiet Operation—Windage noise for a totally inclosed hydrogen-cooled machine is much less than that of an air-cooled machine, permitting designs of greater speed and consequently of lesser bulk. A high-speed machine cooled with hydrogen is quiet and can be operated in locations where objections to noise would prohibit the use of an air-cooled machine.

A study of the calculated segregated losses of two 20,000-kva., 12,500-volt synchronous condensers, one of the conventional air-cooled type and the other of the newer hydrogen-cooled type, shows a considerable saving in the no-load losses in the hydrogen-cooled unit, with a corresponding marked increase in the load losses at rated kva. However, the total losses at rated kva. of the hydrogen-cooled machine are well below those for the air-cooled machine. The group of curves on page 459 illustrates these features.

As stated previously, operating costs must be kept to a minimum, therefore on the San Joaquin system all electrical equipment is carefully studied as regards



One-line wiring diagram of 20,000-kva. synchronous condenser installation

segregated losses. From the many factors which enter into proper evaluation of losses in synchronous condenser equipment, such as cost of power, cost of money, load cycle, etc., the following values have been decided upon and the information given to the manufacturer to apply to his design:

	Per Kw.
No load loss at 100 per cent voltage	$300
Load loss at rated output	$100

Applying these values to the segregated losses shown (page 460) and assuming that the zero loss is the no-load or constant loss, the curves (page 459) are constructed. Herein the difference between the evaluation of losses of the air-cooled condenser and the hydrogen-cooled type represents the additional amount of money which might be paid for the hydrogen-cooled type machine. But the interesting thing is that the difference in the purchase price of the two types of machines is very much less than that which the loss evaluation study indicates might be paid for the more efficient equipment.

Installation cost comparisons

Based on the fact that transformer capacity was available in either case, the following comparison of installed costs is made between the outdoor hydrogen type and the conventional indoor type proposed as an alternate:

20,000-kva. hydrogen-cooled outdoor type, including outdoor oil circuit breakers, crane, cooling equipment, switchboard and control equipment only, in existing building, engineering design, supervision and general office overhead at $7.75 per kva., installed (actual)	$155,000
20,000-kva. air-cooled, indoor type, including addition to existing building, oil circuit breakers, crane, cooling and fire-fighting equipment, switchboard and control equipment, engineering design, supervision and general office overhead at $7.50 per kva., installed (estimated)	$150,000

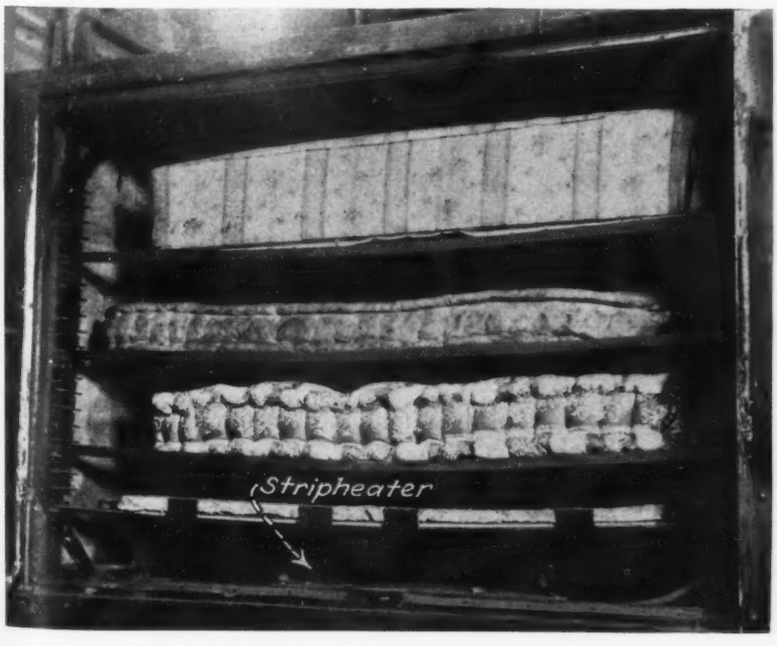
Comparing the differences in installed cost of $5,000 in favor of the air-cooled type, the data on page 459 indicate an evaluation of losses of $27,500 in favor of the hydrogen-cooled type.

No particular problems were encountered in the erection of this unit, and by operating in air for a short time check was made against any trouble before sealing. A special effort was made to have the unit free from hydrogen leaks and all joints, welds, etc., were tested at 25 lb. air pressure and with soap solution. No great difficulty was experienced in making all joints tight, but the interesting thing was that fine leaks appeared in the frame welds. These were made tight by calking. The additional labor required for the assembly of this type of equipment due to the necessity of hydrogen-tight joints and fittings is about 10 per cent over the labor required for the conventional type, where such joints are not required.

With the addition, first, of carbon dioxide to expel all the air, and then the filling with hydrogen, the unit has operated continuously. To free the unit of air with carbon dioxide required the services of two men for eight hours, principally to check on conditions. Two hundred pounds of carbon dioxide costing $16 were used. Hydrogen was then added, expelling the carbon dioxide. The services of two men for checking on conditions were required for eight hours. Hydrogen for the initial filling cost $60. In operation, the loss of hydrogen is automatically made up at a cost not exceeding 10 cents per day.

Particularly striking is the quiet operation. One standing alongside the unit when it is running can hear only the 60-cycle hum, as in a transformer, and only by going to the end and seeing the revolving field rings is it realized that the unit is rotating.

This unit has been in operation too short a time to predict that no trouble will ever be had, but if the first few months are any indication of the future it can quite properly be stated that in any future installation favorable consideration will be given to the hydrogen-cooled, outdoor-type synchronous condenser.



Electric Ovens Used to Sterilize Mattresses

Three distinct advantages—(1) automatic control and, consequently, less labor, (2) removal of fire hazard and (3) small amount of maintenance required—were major considerations affecting the selection of a 10.5-kw. electric oven for sterilizing mattresses, according to the owner of the Pearsall Mattress & Upholstering Company, Roanoke, Va. The sterilizer built by Fred Franke & Company, Louisville, Ky., contains removable racks that may be spaced at various intervals to accommodate different thicknesses of mattresses and thus utilize the oven space most efficiently. Twenty-one 500-watt General Electric strip heaters are mounted on the bottom of the oven and shielded from the nearest mattress by an insulating barrier. A small motor-driven fan attached to one side of the oven provides air circulation. Bristol control instruments regulate the temperature.

The mattresses are baked about one hour at a temperature of 230 deg. F., after which they are re-covered and ready for service. Mrs. E. R. Pearsall, the owner, says that the installation has given satisfaction and has been the means of building up a good business.

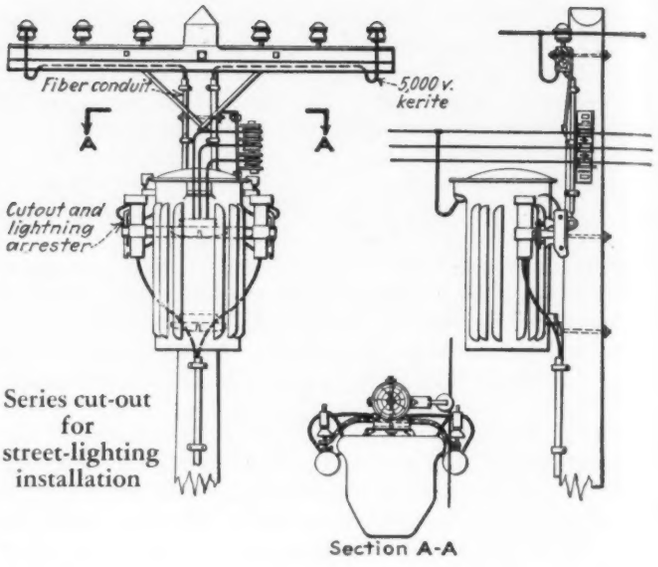
Promoting Safety by Engineering Design

By A. L. COLLIGAN

Engineer Central Hudson Gas & Electric Corporation

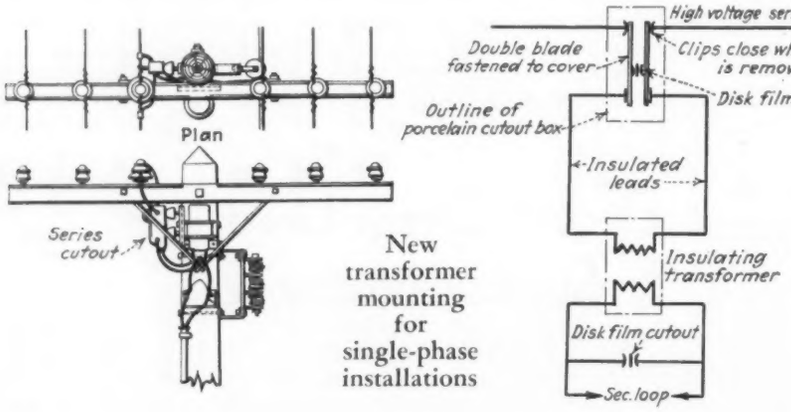
During the past few years large sums of money have been expended for the promotion of safety by public utilities. Employers have provided safety equipment and appliances to be used in first aid and resuscitation work and have furnished an abundance of protective equipment to safeguard the workmen in any of the tasks that must be performed. In spite of all these costly precautions accidents still occur. Although experience shows that most accidents were avoidable and could have been prevented if the employee had performed his duty, it is apparent that we must go farther and minimize the need for unusual precaution on the part of the workman.

As we look back over the type of construction and the methods employed in overhead line construction work during the past 25 years very little advancement or improvement has been made, generally speaking. Transformer installations are mounted at the top of the pole, requiring the maximum labor for hoisting the equipment to the top of the pole and, in cases of live line work, making it relatively difficult to install arresters, cutouts and special materials, as the lineman has to guard himself from contact with live parts. Furthermore, field assembly involves considerable ground work along streets and highways subject to the dangers of increased traffic.



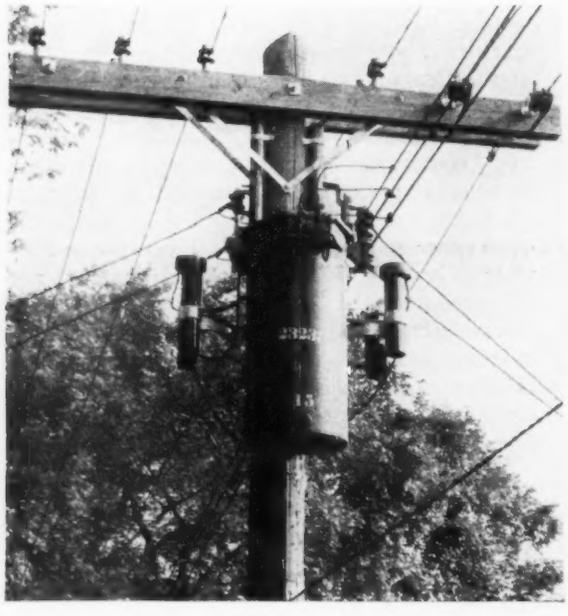
Series cut-out for street-lighting installation

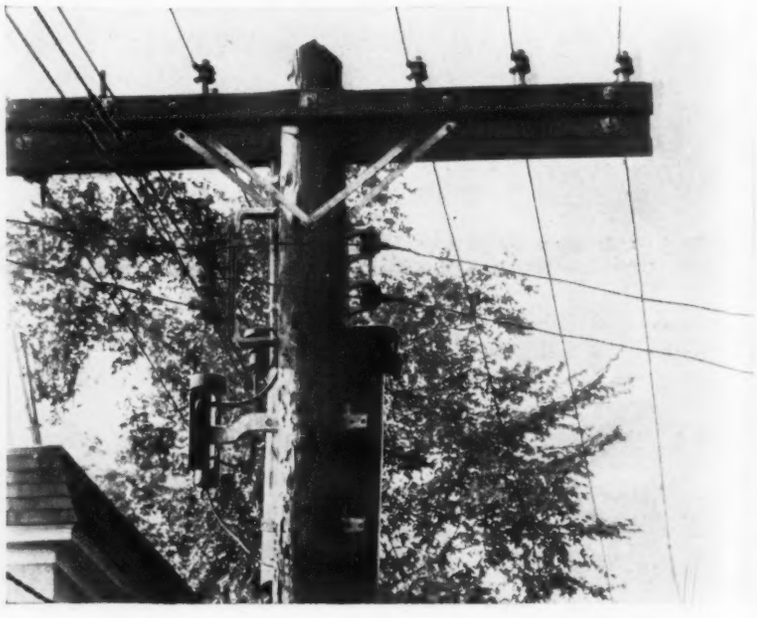
In an effort to minimize these dangers a new type of single-phase distribution-line transformer installation has been developed which is believed to afford a number of improvements over present type construction. A new type of transformer hanger is employed, consisting of two Z plates, which are bolted directly to the pole. Brackets on which lightning



New transformer mounting for single-phase installations

Phase-to-phase and phase-to-neutral installations





arresters and fused cutouts are mounted are attached to the transformer mounting plate. One of these brackets is used for a phase-to-ground-neutral installation, while two brackets are used for a phase-to-phase installation. Live-line connections from the primary wires to the cutouts are run under the crossarm in a special creosoted wood molding, which is easily nailed to the arm. "Kerite" wire is run in fiber conduit in the short vertical run from the arm to the cutout. A small, inexpensive live-line connector is employed for connecting the leads to the primary line wires.

The unit, consisting of transformer, Z plates, brackets, cutouts and arresters, may be assembled in the shop and hoisted by means of a block and tackle, without the use of a special transformer derrick or without unusual strain on the lineman. All pole assembly is performed below the live wires with the exception of the connection of the live-line connectors to the primary wires. A minimum amount of line leads is exposed and fused cutouts are reasonably close to the pole, allowing easy fuse renewal. If a transformer is defective the entire unit may be lowered safely and quickly by removing four bolts and the two transformer leads which are fastened with screws in the cutouts. A defective arrester or cutout can be replaced with the entire installation de-energized by disconnecting the live-line connectors. The transformer is rigidly attached to the pole, obviating any possibility of detachment by sudden impact.

Insulating transformers for street-lighting circuits, employed primarily for connecting low-voltage ornamental underground circuits to high-voltage series cutouts, are ordinarily connected directly to the high-voltage source with no provision for safe removal without interruption to the series circuit. To overcome this a cutout has been developed which allows isolation of the transformer without interruption to the series circuit or without the installation of jumpers. This cutout is housed in a porcelain box similar in appearance to a standard line cutout. The wiring diagram of the circuit and detail of the installation is shown in an accompanying illustration. When the cutout is opened the series circuit is automatically closed and the insulating transformer is disconnected from the circuit. Clips are provided on the blade for the insertion of a disk-film cutout, to prevent interruption to the series circuit, if the cover is closed without the insulating transformer in the circuit. The cutout is installed directly under the arm, with short heavily insulated leads between the series circuit and the insulating transformer. The insulating transformer and secondary film cutouts are attached to the pole by means of the new standard distribution transformer mounting plates. This results in a neat, compact installation which may be installed and maintained safely.

Both of these improvements were designed to promote greater safety, and not only is this accomplished but also an installation of improved appearance is obtained at favorable cost.

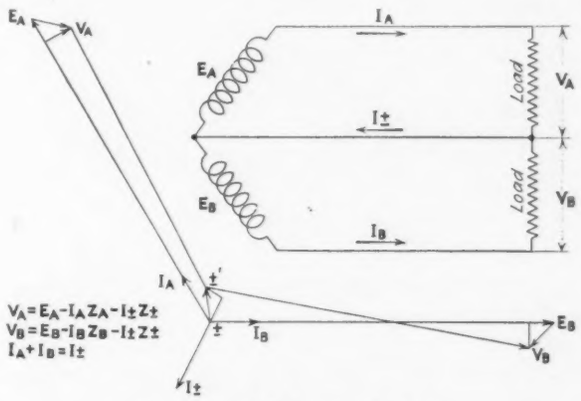
These devices were developed by the engineers of the Central Hudson Gas & Electric Corporation with the co-operation of the officials and engineers of the General Electric Company. The mounting plates and brackets for distribution transformers and the special cutout for street light circuits are now items of standard production supplied by the General Electric Company.

Caution Needed in 3-Wire Services from 4-Wire Networks

By NOBLE G. LARSON

Bureau of Circuit Design, Commonwealth Edison Company, Chicago, Ill.

Lighting loads may be supplied from one, two or three phases of a four-wire, low-voltage, secondary network. Small loads usually are served single phase and larger loads from two or three phases. When three phases are used four wires are necessary and three wires are required if two phases are used. In serving larger loads the service to a building may be either three or four wire. In case it is four wire the wiring in the building may be three or four wire. When a district is being changed over to a network system very little, if any, re-



Beware of the neutral shift

arrangement of interior wiring in existing buildings may be necessary using three-wire interior distribution, while if four-wire interior distribution is used considerable rearrangement work will be required.

But the three-wire system should not be used until calculations of voltage drops have been made to determine whether or not the voltage regulation will be satisfactory. When this system is used the neutral wire carries the same ampere value of current as the phase wires, with balanced load. The voltage regulation is much poorer than with the old three-wire direct- or alternating-current systems. Calculations and tests for existing wiring layouts designed with ample copper show that the phase wire to neutral voltage at the load may be actually higher than at the transformer on one phase and may be of the order of 5 per cent lower than at the transformer on the other phase. This is due principally to the reactive component of the neutral shaft, which tends to lower the voltage of one phase and increase that of the other.

These circuit equations and vector diagram illustrate what may happen in a three-wire service from a network. In order to simplify calculations it is assumed that the load current is in phase with the transformer voltage. This assumption introduces but little error. The load neutral is displaced from the transformer neutral by the impedance of the neutral path. This may cause perplexing voltage conditions at the load.

Photo-Cells Protect Public from Power-Operated Doors

By CHARLES E. ELLIS, Jr.
Engineer Westinghouse Electric Elevator Company

Since the time spent while an elevator stands awaiting the closing of its doors is wasted, the modern trend is to move elevator doors faster and faster until today, five years after the practical application of electric motors to move elevator doors, one second suffices to open or close the average door. To move thus quickly heavy door panels involves the use of considerable force, sufficient to injure a passenger badly if he gets caught by the door's leading edges. Recently, insurance companies have been viewing with growing interest the increasing number of accidents directly due to elevator door impacts. Some means have been needed to make power doors safer.

In R. H. Macy's department store, New York, this protective feature has been provided on all elevators having electric door-operating equipment by projecting across the door opening beams of light, like bars, onto photo-electric tubes. If the beams are obstructed by a passenger's coat, head or leg the door's closing movement is automatically reversed.

The photo-tubes are connected in series and operate a simple amplifier, mounted on top of the elevator car, comprised of a vacuum tube and a relay. This amplifier translates the minute current caused by light striking the photo-electric tubes into one of sufficient magnitude instantly to reverse the door control relays.

All of the parts are worked much below capacity, insuring long life and stability of adjustment. Shutdowns due to "Safe-T-Ray" installation at Macy's are confined to infrequent renewals of the light projector lamps. Projector lamps last about 2,700 hours of continuous service, amplifier tubes and photo-cells eighteen months of installed life, and often longer. Some units of the Macy installation have been in service two years without renewals except for relamping projectors.

▼ ▼ ▼

READERS' FORUM

Water Power Economics

To the Editor of the ELECTRICAL WORLD:

In your issue of January 23 Joel D. Justin has pointed out some of the oversights by Geo. A. Orrok in his comparison of the economies of water power and steam-generated power, and in your issue of January 9 Prof. A. G. Christie, in a brief paragraph touching upon water power, has been a little more liberal in his treatment.

Mr. Justin very justly points out the error of assuming the same fixed charges for hydro and steam plants, but it is believed that he did not stress this point sufficiently. In the case of some large power plants more than half of the investment is in dam and reservoir and half of the remaining cost is in a substantial power house (constituting an extension of the dam, oftentimes), upon which depreciation is very light. The cost of hydraulic and electrical machinery therefore constitutes only 25 per cent of the investment.

In such a case an allowance of 0.5 of 1 per cent for amortization and depreciation upon 75 per cent of the investment would in many cases be ample and an allowance of 3.1 per cent for amortization and depreciation of the machinery would seem to be sufficient. Therefore, the average for the investment would be 1.15 per cent. Allowing 6 per cent for the capital, 2 per cent for taxes and 1.15 per cent for amortization and depreciation, you have a fixed charge of 9.15 per cent if overhead and insurance be neglected. In the case of a steam plant you would have 6 per cent for capital, 2 per cent for taxes and different people estimate amortization and depreciation upon a steam plant at various figures. Two and one-half per cent is often used, but the writer believes it should be at least 3.15 per cent, or even a little higher. But using this figure, you have a fixed charge of 11.15 per cent, which is 2 per cent higher than in the case of a hydro plant.

Two per cent for taxes has been used in each case. This will, of course, vary in different localities, but 4 per cent, as used by some, would seem to be excessive, or even confiscatory.

As both Mr. Justin and Mr. Christie have expressed it, the value of a hydro plant in a system will depend upon the size of the system, the shape of its load curve relative to the pondage capacity of the hydro plant and the relative output of the system to the capacity of the hydro plant. In this connection there is a specific saving that may be pointed out. With sufficient hydro capacity in the system (assuming ample pondage), the customary reserve capacity of the steam plants of 20 per cent might safely be cut to 10 per cent, in very many instances.

It is the writer's opinion too that many engineers underestimate the cost of ordinary upkeep and operation. Costs kept on some large modern steam power units over periods of five years have shown operation and upkeep costs of 1 mill or more per kilowatt-hour on good load factors. In one case these items for boiler room costs alone amounted to 1 mill per ton of coal consumed. It is my opinion, therefore, that the station expense alone of operation and ordinary upkeep should not be placed below 1 mill per kilowatt-hour on a good load factor—40–60 per cent.

On the other hand, Mr. Orrok seems to estimate the operating cost of hydro plants much too high, if the station expense of operation and ordinary upkeep alone is included. Two dollars and sixty cents per kilowatt-year would certainly be excessive for plants of a capacity of 50,000 or 60,000 kw. and twice too much for the largest hydro plants.

One objection to Mr. Orrok's discussion is that he generalizes too much. Engineers who have not made a study of the subject are apt to give his analysis of the subject too much weight. Each hydro plant in a system requires a special study in connection with the system demand to determine its value, or lack of value to the system. Generalization will not do.

Chattanooga, Tenn. JOSEPH WRIGHT.

Men of the Industry

Lamme Medal Awarded to Giuseppe Faccioli

The 1931 Lamme medal of the American Institute of Electrical Engineers has been awarded to Giuseppe Faccioli, Pittsfield, Mass., "for his contributions to the development and standardization of high-voltage oil-filled bushings, capacitators, lightning arresters and numerous features in high-voltage transformers and power transmission" and will be presented at the summer convention of the Institute, which is to be held in Cleveland, Ohio, June 20-24, 1932.

Mr. Faccioli, who retired on May 27, 1930, from his active duties as works engineer and associate manager of the Pittsfield works of the General Electric Company and became a consulting engineer for the company, was born in Rome, Italy, in 1877 and was graduated with high honors from the Institute of Technology, Milan, Italy, as an electrical and mechanical engineer, in 1899.

His early American experience was secured in the New York Edison, Interborough Rapid Transit and Crocker-Wheeler companies. His work soon attracted the attention of the late William Stanley, who induced Mr. Faccioli to become his principal assistant in his laboratories in Great Barrington, Mass. When the Stanley laboratories were absorbed by the General Electric Company, in 1906, Mr. Faccioli was given broader duties in the engineering department of the Pittsfield works.

Mr. Faccioli early became deeply interested in the high-voltage transmission of power and during many years in intimate association with Doctor Steinmetz in the solution of high-voltage problems. He has contributed many technical papers on electrical engineering subjects and has received patents on various types of electrical equipment. He made many highly important personal contributions to the theoretical studies, design, manufacture and standardization of high-voltage bushings, capacitators, lightning arresters, transformers, and other types of equipment.

Mr. Faccioli is a fellow of the American Institute of Electrical Engineers and has served on many of its committees.

▼

Sir BERNARD E. GREENWELL, vice-chairman of the board of the County of London Electric Supply Company, has been elected chairman in place of the late Sir Harry Renwick, and Lieutenant-Colonel Sir FREDERICK HALL and Sir ROBERT RENWICK have been elected vice-chairmen. Lieutenant-Colonel Sir Frederick Hall has also been elected chairman of the board of the South London Electric Supply Corporation, in place of the late Sir Harry Renwick.

▼

Wylie Brown Heads New Organization

Announcement has been made that Wylie Brown has been appointed president of the newly formed Phelps Dodge Copper Products Corporation. Mr. Brown is now president of the Habirshaw Cable & Wire Corporation and the National Electric Products Corporation. Offices will be established March 21 at 40 Wall Street, New York, adjacent to the offices of the parent company, the Phelps Dodge Corporation.

General Electric Engineers Honored

Honors have been recently bestowed on Dr. W. D. Coolidge and Dr. Irving Langmuir, associate directors of the research laboratory of the General Electric Company at Schenectady. Dr. Coolidge received the Washington award of the Western Society of Engineers, as announced in the February 27 issue of the ELECTRICAL WORLD, and Dr. Langmuir is this year's winner of the *Popular Science Monthly* annual award of $10,000 for notable scientific achievement.

Dr. Coolidge has had a distinguished career in the field of engineering research covering 27 years. He was graduated from the Massachusetts Institute of Technology in 1896, afterward receiving his Ph.D. from the University of Leipzig. Returning to the United States, he joined the teaching staff of the Institute, serving as assistant in physics, instructor in physical chemistry and as assistant professor of physico-chemical research. In 1905 he became a member of the staff of the General Electric research laboratory under Dr. Willis R. Whitney, and in 1908 was made assistant director of that organization, a position he occupied until 1928, when he was made associate director.

Among Dr. Coolidge's achievements are ductile tungsten used for lamp filaments, wrought tungsten used for contacts and X-ray targets, the hot-cathode X-ray tube, various types of X-ray generating equipment, the C tube for submarine detection and signaling and the cathode-ray tube. Without his improvements the X-ray tube was feeble and dangerous to operate. His cathode-ray tube has unknown possibilities in science and medicine, for its beam has the power of a ton of radium.

In 1914 he received the Rumford Medal and has subsequently been awarded the Homer N. Potts medal, the Lewis Edward Levy gold medal, the gold medal of the American College of Radiology, the Hughes medal from the London Royal Society and the Edison medal. He holds the honorary degrees of doctor of science from Union College and from Lehigh University.

Dr. Langmuir was singled out for this distinction in recognition of his numerous contributions to pure and applied science, among which his inventions of the nitrogen-filled incandescent electric light bulb and the atomic welding arc are conspicuous. The award, together with a gold medal commemorating it, was presented to Dr. Langmuir on February 29 in New York City.

Dr. Langmuir's scientific career covers a period of a quarter century. He entered the General Electric research laboratory in 1909 after spend-

ing three years on the teaching staff of the Stevens Institute of Technology. From the practical point of view, Dr. Langmuir's outstanding achievement is his invention of the nitrogen-filled incandescent electric light bulb. This improvement has reduced by 50 per cent the cost of more than half the electric current bought in the United States for lighting purposes. The gas-filled lamp is only one of several practical results of Dr. Langmuir's extensive researches. He has carried out successful work on the vacuum lamp and on radio tubes. His long study of atomic hydrogen was responsible for his development of the atomic hydrogen torch, the use of which in welding is expanding daily.

Twice Dr. Langmuir was awarded the Nichols medal by the New York section of the American Chemical Society. In 1918 the Royal Society of London bestowed upon him the Hughes medal for his researches in molecular physics, and the American Academy of Arts and Sciences, in 1920, awarded him its Rumford medal for his thermionic researches and his gas-filled lamp. In 1925 he was the recipient of the Cannizaro prize from the Royal Academy of Lincei, in Rome, Italy, and in 1928 of the Perkin medal.

▼

FRANK W. SMITH, president of the New York Edison Company, has been elected a director of the Brooklyn Edison Company.

•

CHARLES E. MITCHELL, chairman of the board of the National City Bank, and GEORGE WHITNEY, member of the firm of J. P. Morgan & Company, were added to the executive committee at the recent meeting of the board of directors of the New York Edison Company.

•

LEON V. QUIGLEY has established his own business as counsel on public relations, with headquarters in New York. During the past seven years, as technical editor of the Bakelite Corporation, Mr. Quigley has been director of public relations, publicity and the educational program of that company. He is a graduate of Worcester Polytechnic Institute with the degrees of B.S. and M.S. As an instructor in the department of chemical engineering at Worcester Tech he became familiar with the educational viewpoint and during six years' work in the wholesale and retail drug business he obtained experience in merchandising. A contributor to newspapers and magazines of this country and of England, he has had some experience in newspaper work. During his connection with the Bakelite Corporation he became well known as a lecturer.

Torchio and Grove Assume New Executive Duties

Philip Torchio, senior vice-president of the New York Edison Company, who was elected to a similar position with the United Electric Light & Power Company, as announced in a recent

Philip Torchio

issue of the ELECTRICAL WORLD, is both an engineer and an economist. During his professional career he has followed closely high-tension cable work and it is to his original researches that much of the development in this field can be traced. In addition, he was responsible for the introduction of thin-plate storage batteries for central station standby service and is the patentee of many valuable devices for improvements in electrical apparatus and equipment.

Mr. Torchio established a reputation as an economist when he advocated the superpower system idea. It was 30

R. B. Grove

years ago that he called attention to the value of interstation ties between plants of different companies. He advocated the group insurance plan adopted by the larger insurance companies, such as the Metropolitan Life, to which he originally submitted it in 1910.

A native of Italy, Mr. Torchio came to the United States upon the completion of his technical education and joined the New York Edison Company in 1895. He was chief electrical engineer from 1905 to 1924, when he was made vice-president in charge of electrical engineering, assuming the duties of senior vice-president less than a year ago. He is a fellow of the American Institute of Electrical Engineers and a member of various other engineering societies.

Robert B. Grove, who was recently elected a vice-president of the New York Edison Company, has been a vice-president of the United Electric Light & Power Company for the past year. He has completed more than 25 years of service with the United organization, having started as draftsman in 1907. He then became successively general assistant in the engineering department, assistant to the electrical engineer, assistant to the vice-president and general manager and assistant secretary. In 1928 he was named secretary, which position he relinquished last year to assume a vice-presidency. Mr. Grove has been active in the National Electric Light Association, having served on various committees.

▽

OBITUARY

John T. Harrington

John T. Harrington, attorney, financier and philanthropist of Youngstown, Ohio, died February 28, at the age of 58, in Sydney, Australia, while on a world tour. Mr. Harrington was a director of the Commonwealth & Southern Corporation; a vice-president and director of the Ohio Edison Company, having been president of one of its component companies, the Pensylvania-Ohio Power & Light Company; a director of Ohio Leather Company and General Fireproofing Company, a member of the executive committee and until recently a director of the Republic Steel Corporation. He was born in Rock Creek, Ohio, studied at Oberlin College and the University of Michigan and after practicing law a few years in Jefferson, Ohio, he removed to Youngstown in 1900. He handled legal matters for utilities and became a close friend of R. P. Stevens, public utility executive, with whom he went into various utility undertakings. He entered the steel business with the crash of Trumbull Steel, in which he was a heavy stockholder, when he persuaded Cyrus S. Eaton to come to the rescue and he himself became president of the company. When Trumbull Steel became part of the Republic Steel Corporation he was made a director of Republic.

Trade News

Dubilier Expands Condenser Department

Dubilier Condenser Corporation, New York, announces the expansion of the electrolytic condenser department as well as the installation of much new equipment. With the introduction of a better dielectric film in its electrolytic units the company expects larger business in this type capacitor.

With considerably improved characteristics, due to a radical departure in the formation of the oxide dielectric film on the aluminum foil, the small electrolytic condenser is ready to go outside the radio field and finds many applications in electrical and industrial functions.

▼

Dr. Kenneth Dameron, College of Commerce, Ohio State University, has been retained by the electrical merchandising joint committee to conduct a survey on the merchandising of electrical appliances. A portion of the survey will be devoted to the problem of merchandising appliances by utilities.

•

Thomas C. Dee, 808 Third Street, Jackson, Mich., formerly with the Consumers Power Company and Allied Engineres, Inc., in that city, has been appointed a representative of the W. N. Matthews Corporation, St. Louis, Mo., for territory in the state of Michigan. Mr. Dee has served successively as an office manager, a district manager and as a district superintendent for the Consumers Power Company and their affiliated branches in Michigan.

•

Directors of the Electric Controller & Manufacturing Company have declared a quarterly dividend of 75 cents per share on the common stock, payable April 1 to holders of record March 19. Previoulsy the company made regular quarterly distributions of $1.25 per share on this issue.

•

The Burke Electric Company of Erie, Pa., manufacturer of a complete line of motors, generators, electric welders, etc., announces that beginning March 1, 1932, distribution of its complete lines in the Chicago district will be handled by Albert J. Walz as distributor. Mr. Walz's quarters will be at room 200, 205 West Wacker Drive, Chicago. The Burke Electric Company also announces that P. J. Burrill and J. L. Vergillio are likewise general distributors for northern Ohio and are at 942 Prospect Avenue, Cleveland.

•

Master Electric Company, Dayton, Ohio, has inaugurated a new teletypewriter switching service between the company's main office at Dayton and the various factory branches throughout the country, using the service of the American Telephone & Telegraph Company. It is similar to long-distance telephone in that it is operated through central switchboards located in the various cities and permits direct written communication between various organizations equipped with teletypewriters.

▼

AN ALL-BUT-HUMAN FIRE ALARM

—*Acme*

This vacuum-tube fire and burglar alarm, invented by L. W. Skala of Cicero, Ill., is said to ring a bell, signal firemen, sound a siren, take a photograph and set off extinguishers after a three-minute delay. The alarm wires and photo-electric cells operate on less than 0.2 micro-ampere. The wires ground at 125 deg. F., ringing the alarm.

Blaw-Knox Company and the Western Pipe & Steel Company of San Francisco and Los Angeles have closed an agreement whereby Western Pipe & Steel will manufacture Blaw-Knox products on the Pacific Coast and will sell through the organization of a new company to be known as Blaw-Knox & Western Pipe Corporation. This new concern will be equally owned by the two companies.

•

Square D Company reports net profit, after interest and federal taxes, of $78,443 for the year ended December last. This is equivalent to 77 cents a share and compares with $93,573, or 93 cents a share, in 1930.

•

Kelvinator Corporation reports net loss, after interest, depreciation and other charges, of $508,335 for the quarter ended December 31, compared with net less of $332,612 in 1930.

•

Diamond Electric Manufacturing Company, Los Angeles, which recently took over the Mosher Manufacturing Company in Denver, plans to establish a factory in Denver soon. D. G. Kendall of San Francisco is to be local plant manager and will supervise the new plant's operations. This factory, for the manufacture of electric power switches and panelboards, will be the most easterly of Diamond Electric's divisions. It will be the manufacturing and distribution center for Colorado, Wyoming, eastern Montana, Nevada, Utah and northern New Mexico.

•

F. S. Bird, 4217 Wycliff Avenue, Dallas, Tex., for ten years connected with the Electric Bond & Share Company, has been appointed a representative of the W. N. Matthews Corporation, St. Louis, Mo., for territory in the state. Mr. Bird has spent a great portion of his career as an operating and construction man in Texas.

•

Directors of the Electric Storage Battery Company have declared from the accumulated surplus of the company a quarterly dividend of 75 cents per share on the common and preferred stocks, both payable April 1 to holders of record March 9. Quarterly distributions of $1 each were made on both classes of stock on January 2, 1932, and on October 1, 1931.

•

J. Allen Harlan, until recently vice-president in charge of sales of the Frigidaire Corporation, has joined the Kelvinator Corporation as sales engineer on products. He succeeds J. M. Fernald, who resigned to engage in other activities. In 1921 Mr. Harlan became actively engaged on sales and promotion of Frigidaire, serving in various capacities with a number of titles.

New Equipment Available

Improved Oil Seal Withstands Liquid Pressure

An oil bearing seal consisting of but four parts, a self-contained and complete unit which can be shipped in or out of position, with nothing to work loose or become lost, has been announced by the Aetna Ball Bearing Manufacturing Company, Chicago. This device consists of an outer shell of steel, accurately formed and ground on an outside diameter to a precision commensurate with that of anti-friction bearings. This shell houses the seal cushion, pressure plate and steel retainer.

The thermo-pneumatic seal cushion consists of specially treated cork in which the interstices or air cells are captivated and hermetically sealed. This pneumatic seal cushion automatically expands and contracts laterally with changing temperature of shaft or lubricant, remaining always oiltight in consequence. It is non-hygroscopic and impervious, is of great resiliency, has a low friction coefficient and is abrasive resistant.

At the present time, when high-pressure lubricating systems are being used so widely, this duplex seal—with the tendency for the two major component parts to seal themselves closer, the stiff yet resilient deflector-pressure plate taking the internal pressure while the softer, pneumatic cushion is relieved of taking the pressure—will, it is claimed, hold oil as well as grease and will operate without trouble where water is held on one side of the seal and oil on the other.

▼

Electric Gage Accurate Normally to 0.0001 In.

An adaptation of the "Electrolimit" gage in the form of a comparator for external gaging has been made by the Pratt & Whitney Company. This new instrument, with a capacity of 4 in., is offered for rapid and accurate inspection of production work.

The energy unit consists of a transformer to reduce outlet voltages to the 10 volts required to operate the gage head and a voltage regulator which reduces the inaccuracies caused by fluctuations in line voltage to about one millionth of an inch for each volt change.

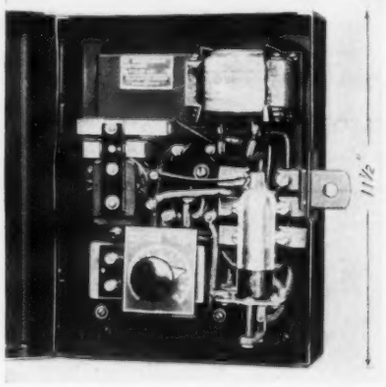
The microammeter mounted on the gaging head permits a standard magnification of the circuit to cause the indicating needle to travel about $\frac{7}{16}$ in. for each 0.0001 in. variation in the sizes of the parts gaged. Magnification can be increased or decreased as desired to suit special conditions.

It is said that the human element, conducive to error, is entirely eliminated because the gaging pressure remains exactly the same as the pressure with which the gage is set initially. High magnification eliminates uncertainties and chances for observational errors.

▼

Electronic Timing Device for Welding Service

A new electronic timing device for spot, projection and other forms of resistance welders which promises wide use in industry is announced by Cutler-Hammer, Inc., Milwaukee, Wis.



The manufacturer claims that extremely accurate timing control of the welding operation for the use of an electronic tube makes possible an accuracy better than a fraction of a second. The device has an adjustable range up to sixteen seconds.

This new tube timing welder control, known as bulletin 13101, is said to eliminate all guesswork on the operator's part, enabling unskilled operators to produce successful welds and to practically eliminate rejects and throw-outs. The timing is adjusted by a knob inside the inclosing case. The device requires but a small mounting space and operates on 110 to 550 volts a.c., 25 to 60 cycles. Vibration, severe or intermittent service will not affect the accuracy of this control, the manufacturer asserts.

Thyratron Tubes Govern Speed of Line Welding

Close and accurate control of the frequency of current interruption in line welding and an increase in speed of interruption up to 1,800 per minute are among the advantages claimed for a new type of thyratron-tube timing control announced by the General Electric Company. The new control replaces mechanical interrupters.

The equipment operates in synchronism with the alternating-current supply of the welding machine. The weld is always started at a predetermined point in the voltage wave and stopped when the current passes through zero. Thus the period of current application can be accurately controlled even with "on" times of but one or two cycles.

The new synchronous tube timer supplements and is designed to work in conjunction with the General Electric welding control type CR 7503, which uses thyratron tubes instead of contactors for interrupting the flow of current. By a combination of the two equipments a very close degree of accuracy and high-welding speed are obtained.

The control embodies a series transformer the primary of which is connected in series with the primary of the welding transformer and the secondary of which is short circuited by two thyratron tubes connected thereto. Welding current will not flow unless the grids of these tubes are properly energized. For controlling and energizing the grids of these thyratrons three small thyratron tubes are used. One in combination with a condenser acts as a timer. This timing thyratron trips when the condenser is charged to a certain point and controls the grids of the other two small thyratrons, which, in turn, control the two power thyratrons. The control has no moving parts and is subject to no such wear as is involved in mechanical interrupters.

▼

THE "LEXTROMETER," a self-starting, electric day-by-day coin-collector clock for refrigerator payments, which is of such design and appearance that it may readily be detached and used in any part of the house after the refrigerator is paid for, is announced by the Chicago Electric Manufacturing Company. The clock jewel light and coin collector remain in operation even though the refrigerator is disconnected and not operating. This insures the collection of payments even though the user is late with coin deposits. A jewel telltale signal over the clock dial lights up when more coins are required and prior to time current is to shut off.